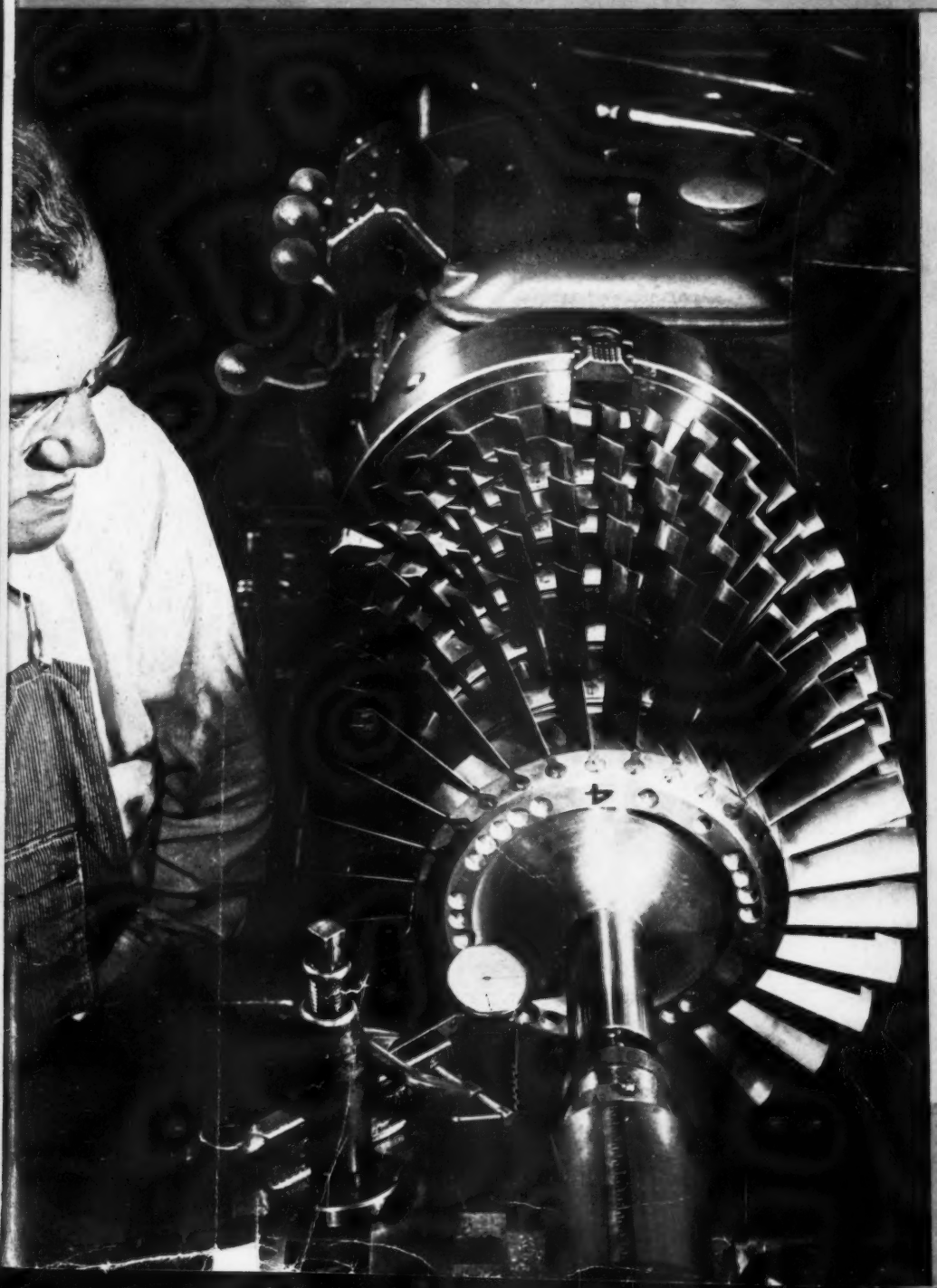
JANUARY
1946

POWER

GENERATION, TRANSMISSION AND APPLICATION OF ALL THE POWER SERVICES



Central-station survey reveals design plans and construction progress in utility expansion program rivalling that of the late Twenties. Trend is toward condensing units operating at moderately high pressures — 700 to 900 psi — and high temperatures — 850 F and up. For a station-by-station roundup, see article beginning on page 64

Gas-diesel principle now applied to supercharged 4-cycle units and to 2-cycle engines. Report on development makes cial reference to performc valving, fuel injection and trol methods. Turn to page

◀ *Forming the heart of most gas-turbine power units, axial-flow compressors like this jet-propulsion element are much in the day's technical news. See articles on page 81 and page 103*

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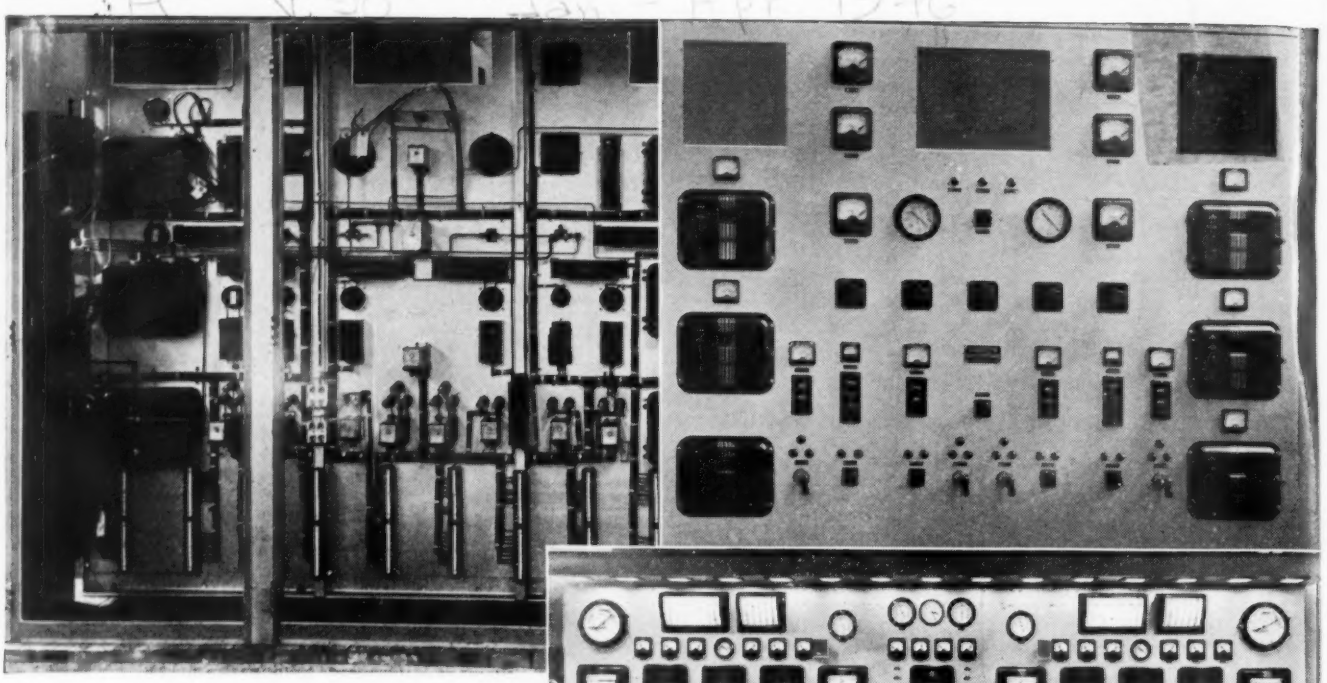


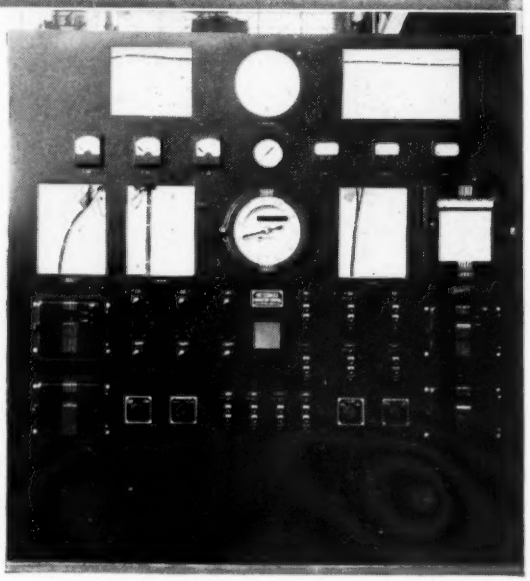
Back and front views, at our plant, of Metermax Combustion Control section of a complete L&N boiler gauge board for Picway Station, Columbus & Southern Ohio Electric Co. Right—Two-boiler L&N Control Board installed at Westover Station, New York State Electric & Gas Corp.

The PLUS VALUES OF PANEL ENGINEERING Give Better Power Plant Control

Panels engineered by L&N have every detail arranged to make the ıit as useful as possible to the power plant's personnel. All Control- 's and instruments—all gauges, dials and meters—all start-stop sta- ns, switches and signal lights—are in proper sequence for conven- : operation. Lighting is bright, level, glareless. Back-of-panel ıngement is exceptionally convenient. Panels show our ten years xperience in supplying *complete* units to meet the problems of er plants.

ıese Panels arrive with Metermax (or Type P) Combustion ·ollers and/or Micromax instruments installed. Major equip- items which we do not make can be supplied or not, but the Panel, down to the last wire, is connected and checked. Either he Panel or ahead of it we send complete structural and wiring nts, which greatly reduce the recipient's engineering and draft- rk. The Panel as received is ready to install.

ıer information will be sent on request.



Labelled in Russian, this is one of eight boiler boards shipped as shown to U.S.S.R. Metermax Controllers and Micromax Instruments are mounted. Wiring for separately-shipped equipment can be seen, cabled and tagged, in cut-outs.

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl. Ad NU52(2)

which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"), January, 1946. Published monthly with an additional Directory number in December. McGraw-Hill Publishing Company, Inc. Publications office, 99-129 North ny 1, N. Y. Editorial and executive offices, 330 West 42nd Street, New York 18, N. Y. Entered as second class matter August 25, 1936, at nder the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions ssed to the Director of Circulation, Power, 330 West 42nd Street, New York 18, N. Y. Subscription rates—U. S. and U. S. Possessions, $3.00 00 for two years. Canada, $3.50 for one year, $5.00 for two years. All other countries $6.00 for one year, $9.00 for two years, 35c per copy.

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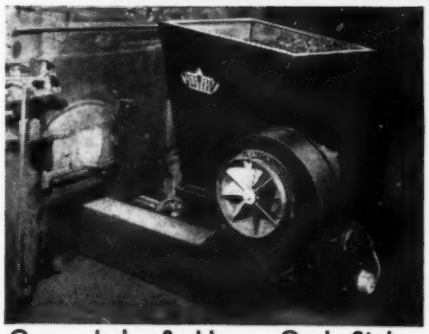
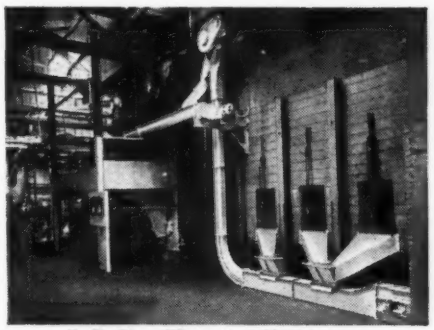
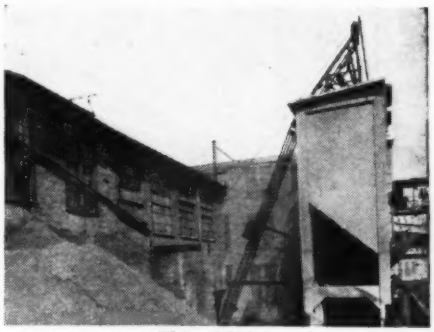
Coal and Ashes Handling Problems with LINK-BELT



Com., Ind., & Home Coal Stokers



Bulk-Flo Elevator-Conveyors



Skip Hoist

Sidekar-Karrier for Bulk Materials

AS specialists in the design, manufacture and application of all types of coal and ashes handling equipment for all types of large and small boiler plants, Link-Belt engineers have learned how to apply an extensive knowledge and experience effectively, to the solution of all kinds of problems. Many new innovations have been developed to meet war time requirements.

Link-Belt line includes: Conveyors of all types, such as belt, bucket, screw, flight, Bulk-Flo, drag chain, apron, Sidekar-Karrier, etc.; bucket carriers and elevators; skip hoists; feeders of all types; weigh larries; car dumpers; traveling car spotters; crawler and wheel mounted cranes; coal crushers; water-intake screens; rotary railroad car dumpers; commercial, industrial and domestic automatic coal stokers; silent and roller chain drives; speed reducers and increasers; variable speed changers; ball, roller and babbitted bearings; pulleys; couplings—the most complete line of materials handling and power transmission machinery.

It will pay you to check your plans with Link-Belt experienced engineers.

Catalogs sent on request. 9949-A

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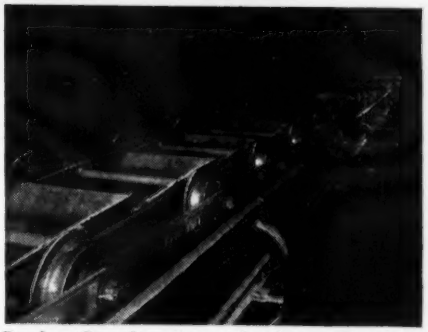
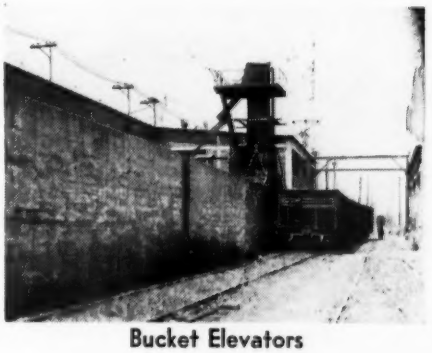
Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.



Peck Overlapping Bucket Carriers

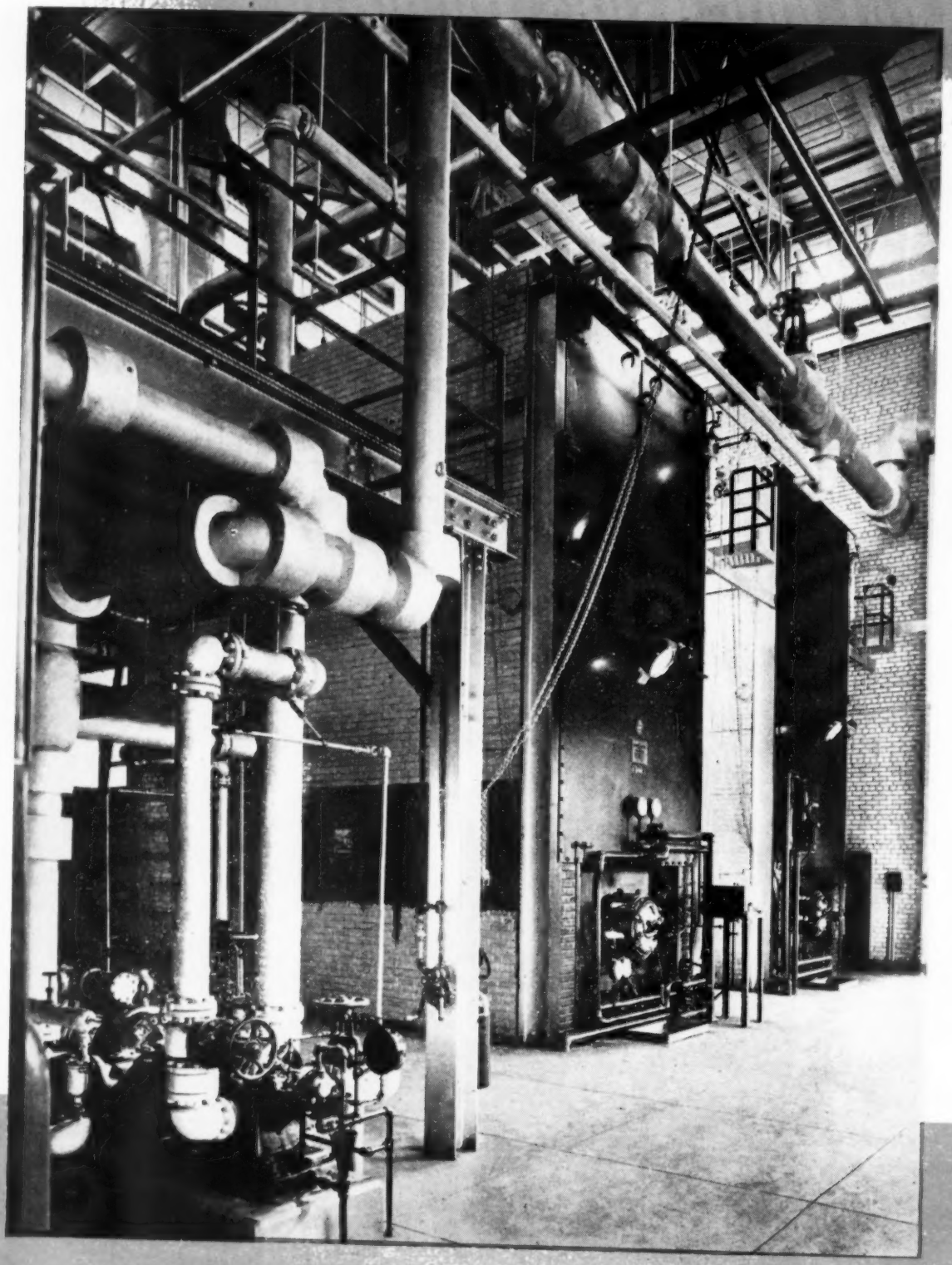
Weigh Larries

Belt Conveyors



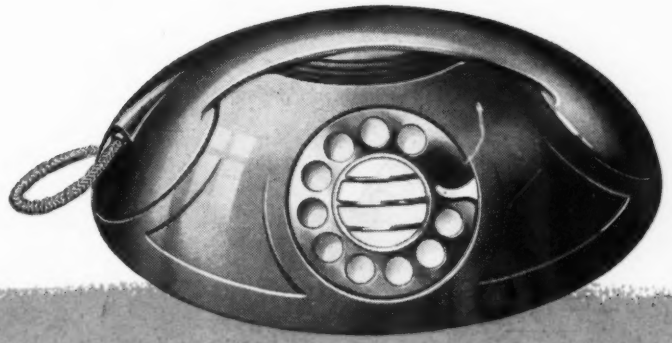
Bucket Elevators

STEAM for



Interior of Boiler Room at Murray Hill unit of Bell Telephone Laboratories, Inc.

Murray Hill



...ANOTHER JOB FOR B&W BOILERS

In the Murray Hill unit of Bell Telephone Laboratories, Inc., research and development organization of A. T. & T. and Western Electric, efficiency is the keynote, from the functional exteriors to the modern steam plant.

All steam for heating, and for scientific use in the unit's many laboratories, is supplied by two B&W *Design 32* Cross-Drum Boilers of the straight-tube, sectional-header type. Each of these boilers is capable of delivering 21,000 pounds of steam per hour at 125 psi and 350 F.

This B&W boiler is attractive for small and moderate capacity steam plants because of its high steaming capacity with minimum headroom and floor space requirements and its straight-tube sectional-header construction, with no pressure parts buried in brickwork. In addition, it is simple to operate and easy to inspect and clean—since the tubes are accessible from outside the boiler. It is low in maintenance expense, due to simple yet durable construction, and in total cost installed ready to put in operation.

You can come to B&W for boilers to meet any steam requirements for power, heating, or processing, with assurance of getting units fitted to your needs for highest standards of performance, dependability, and overall economy. Over 60 years experience in making and applying steam-generating equipment is behind every B&W recommendation.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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STEAM TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • DESUPERHEATERS • FILTERS

ELLIOTT COMPANY, DEAERATOR & HEATER DEPT., JEANNETTE, PA.

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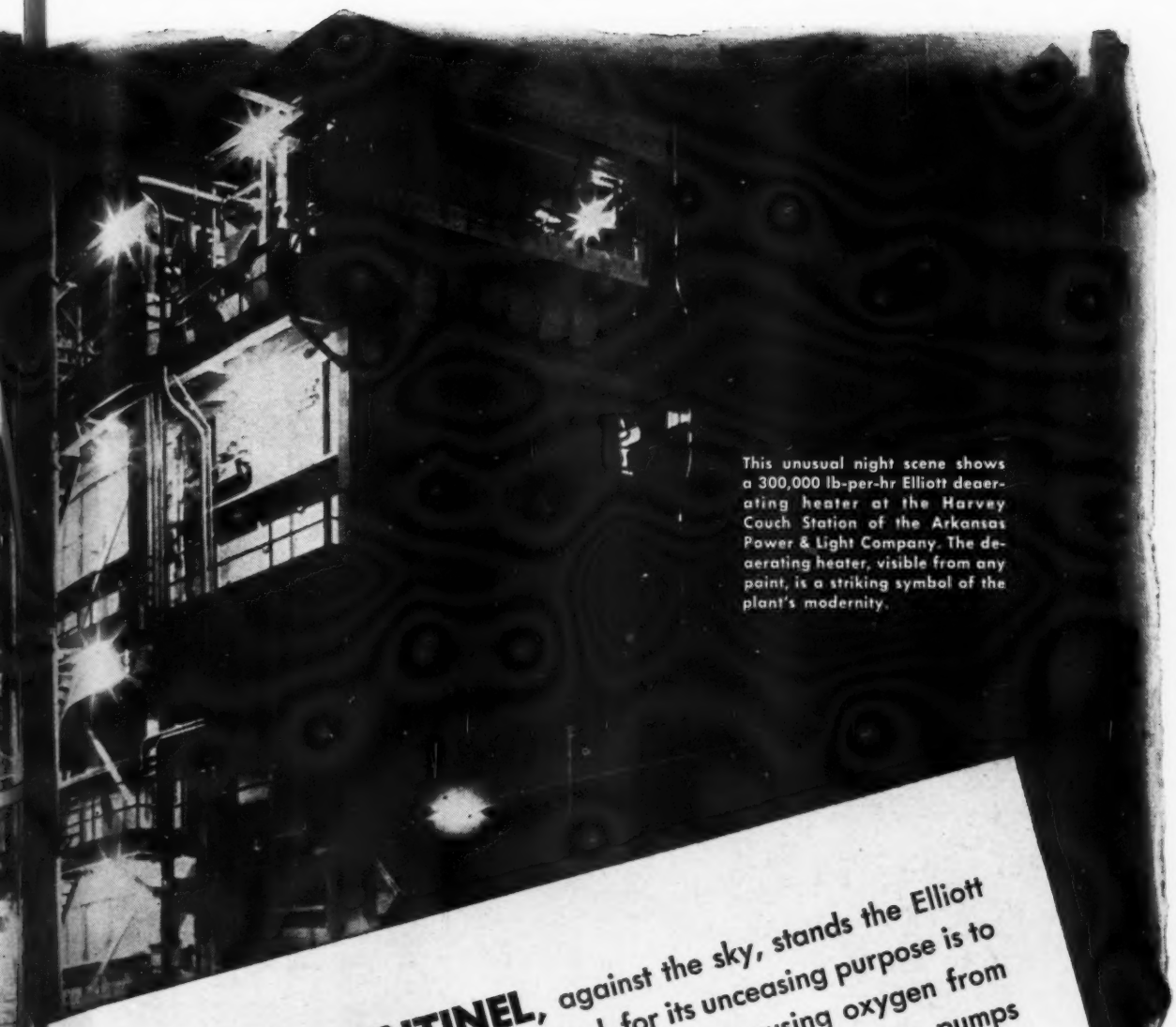
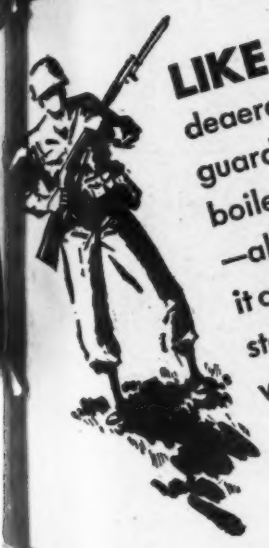
ELLIOTT DEAERATING FEED



This unusual night scene shows a 300,000 lb-per-hr Elliott deaerating heater at the Harvey Couch Station of the Arkansas Power & Light Company. The deaerating heater, visible from any point, is a striking symbol of the plant's modernity.



LIKE A SENTINEL, against the sky, stands the Elliott deaerating heater. It is a sentinel, for its unceasing purpose is to guard the plant by removal of corrosion-causing oxygen from boiler feedwater. It protects boiler tubes, piping, valves, pumps —all water-handling equipment. And while giving this protection, it also provides feedwater heated to the temperature of saturated steam. Night and day this process goes on, quietly, automatically, with no fuss or trouble.

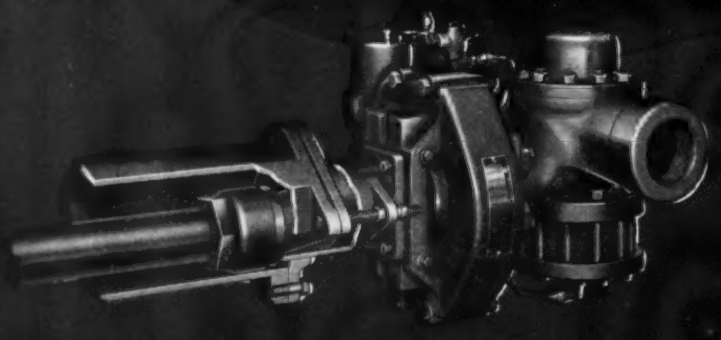
Thousands of plants large and small have used deaeration since Elliott engineers pioneered its development some years ago. This pioneering is still going on—in more and more efficient and economical applications, in the closer fitting of Elliott deaerating heaters to specific conditions. You will find it interesting to discuss your deaeration problem with Elliott engineers.

N-983

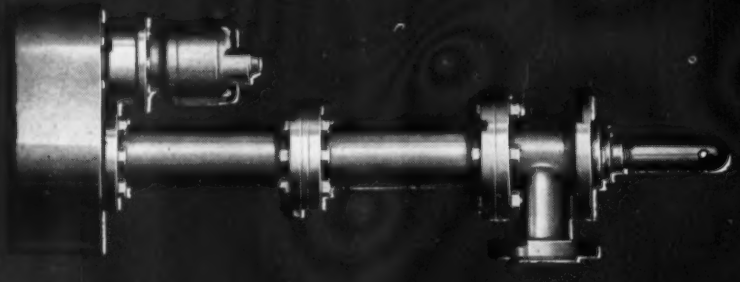
WATER HEATERS ***For boiler plant security and economy***

CLEANER BOILERS

With DIAMOND *Automatic Sequential* AIR SOOT BLOWERS



Diamond "Air Puff" Soot Blower having element permanently installed inside the setting. Compressed air is discharged in a series of short puffs with substantial pauses between. Spreading cleaning cycle over longer period of time permits use of much smaller compressor and eliminates stack discharge nuisance.



Diamond Model IF Short Retracting Soot Blower for cleaning either furnace walls or boiler heating surfaces (by change in nozzle design) where gas temperatures exceed the limit for units permanently installed inside the setting.

DIAMOND POWER SPECIALTY CORP.

Detroit 31, Michigan

DIAMOND SPECIALTY LTD. • Windsor, Ontario

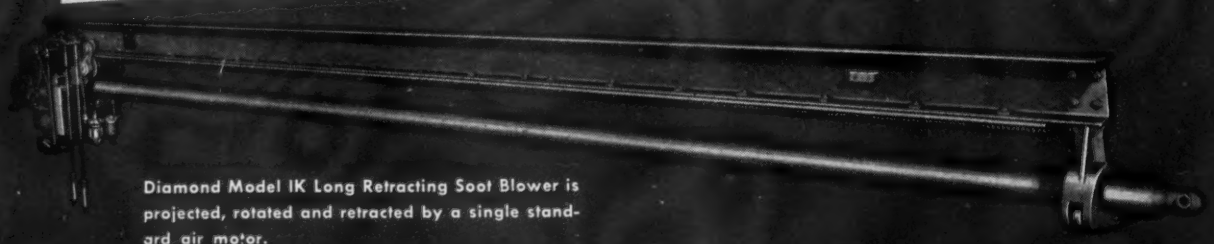
AT LOWER SOOT BLOWING COSTS

When the "Start" control of a Diamond Automatic Sequential Air Soot Blower System is pushed, the program panel takes over. Each blower is operated at exactly the right blowing speed . . . and in the correct sequence. No blower can be skipped or given the quick "once over" which hand-operated blowers often get. Also, compressed air has a greater density than steam and therefore is a better cleaning medium. The combined result is much more effective boiler cleaning.

Automatic operation saves considerable labor cost because it entirely eliminates the need for an operator. Using compressed air makes an additional saving by eliminating feed water makeup. Five years' operating experience has proved maintenance costs are unusually low and that air cleaning uses only ⅓ to ⅔ of the energy from the coal pile that is needed for steam blowing.

Automatic Sequential Air Soot Blower Systems of Diamond design and manufacture have been in successful operation on large central station boilers since 1940.

This program panel controls both fixed and retracting blowers arranged in three groups. Panel can be arranged for any number of groups when system is designed.



Diamond Model IK Long Retracting Soot Blower is projected, rotated and retracted by a single standard air motor.

Diamond "Telescopic" Soot Blower is used where clear space outside the boiler is insufficient for the Model IK Blower. Electric drive shown but air drive also available.

AIR AS A CLEANING MEDIUM

- SAVES FEED WATER MAKEUP
- SAVES LABOR
- SAVES MAINTENANCE
- SAVES FUEL
- SAVES PIPING INSULATION

Blazing THE ..DESIGN FOR 1000°F.

TEMPERATURE CONTROL . . .

Final steam temperature control with an all-convection type superheater invariably requires a compromise between two limiting conditions.

FIRST—when furnace exit temperatures to the superheater are high enough to obtain the desired control range, slagging of the boiler and superheater surfaces may result.

SECOND—when gas temperatures to the superheater are low enough to prevent slagging, the desired control range cannot be met.

The necessity for compromise can be eliminated by using a combination radiant and convection type superheater. Slagging in the boiler and superheater can be eliminated and a high final steam temperature maintained over a wide load range.

FW FOSTER

ENGINEERING TRAIL

FINAL STEAM TEMPERATURE

FIRST . . .

The first high pressure public utility steam generating unit designed for 1000°F. final steam temperature will go into service during 1946 at the Atlantic City, N. J. station of the Atlantic City Electric Company. Capacity is 310,000 lb. steam per hour at a pressure of 1550 psi. This marks another milestone in design progress for high-pressure, high-temperature steam generating units.

PROBLEM . . .

The engineering problem here was to design a superheater which could deliver steam at 1000°F. final temperature over a wide load range, and in addition, satisfy the second condition of slag-free operation.

SATISFYING BOTH CONDITIONS . . .

The Foster Wheeler combination radiant and convection type superheater satisfies both requirements. Offsetting characteristics of the two superheater types balance to yield an almost constant final steam temperature over a wide load range. As the load increases the steam temperature from the radiant section decreases, while temperature from the convection section increases. Condenser type control provides what regulation is necessary to maintain a steady 1000° over the load range of 130,000 lb. to 310,000 lb. steam per hour.

The second condition—freedom from slagging—is the resut of combining radiant and convection heat-absorbing surfaces, permitting the specified temperature of 1000° to be obtained, while furnace exit temperatures to the convection superheater are kept below the slagging point.

FOSTER WHEELER CORPORATION
165 Broadway • New York 6, N.Y.

WHEELER FW

Controlling air in proportion to **B.t.u.** input

A report on the Hagan Differential Master Method of Combustion Control

IN THE FIRING of pulverized coal the accurate maintenance of fuel-air ratio has been hampered by such factors as variation in calorific value of coal, and coal feed mechanisms which are affected by moisture content and coal size.

Since it is a known fact that the air requirement per pound of fuel is directly related to its B.t.u. content, it is possible to overcome this difficulty by a simple and *direct* method of control which for the first time employs the steam flow-air flow relationship *correctly*.

Although not universally applicable, where this relationship can be applied the Hagan differential master method uses the boiler unit itself as a calorimeter of heat input and correctly regulates the air in a positive, *direct* manner. This permits the immediate establishment and continuous maintenance of the correct conditions without relegating the principle to the position of an after correction.

By doing it right the first time there is no necessity for setting up approximate conditions to be handled by a lagging corrector system.

The successful accomplishment of this stems directly from the inherent, high speed, sensitivity and stability of Hagan apparatus.

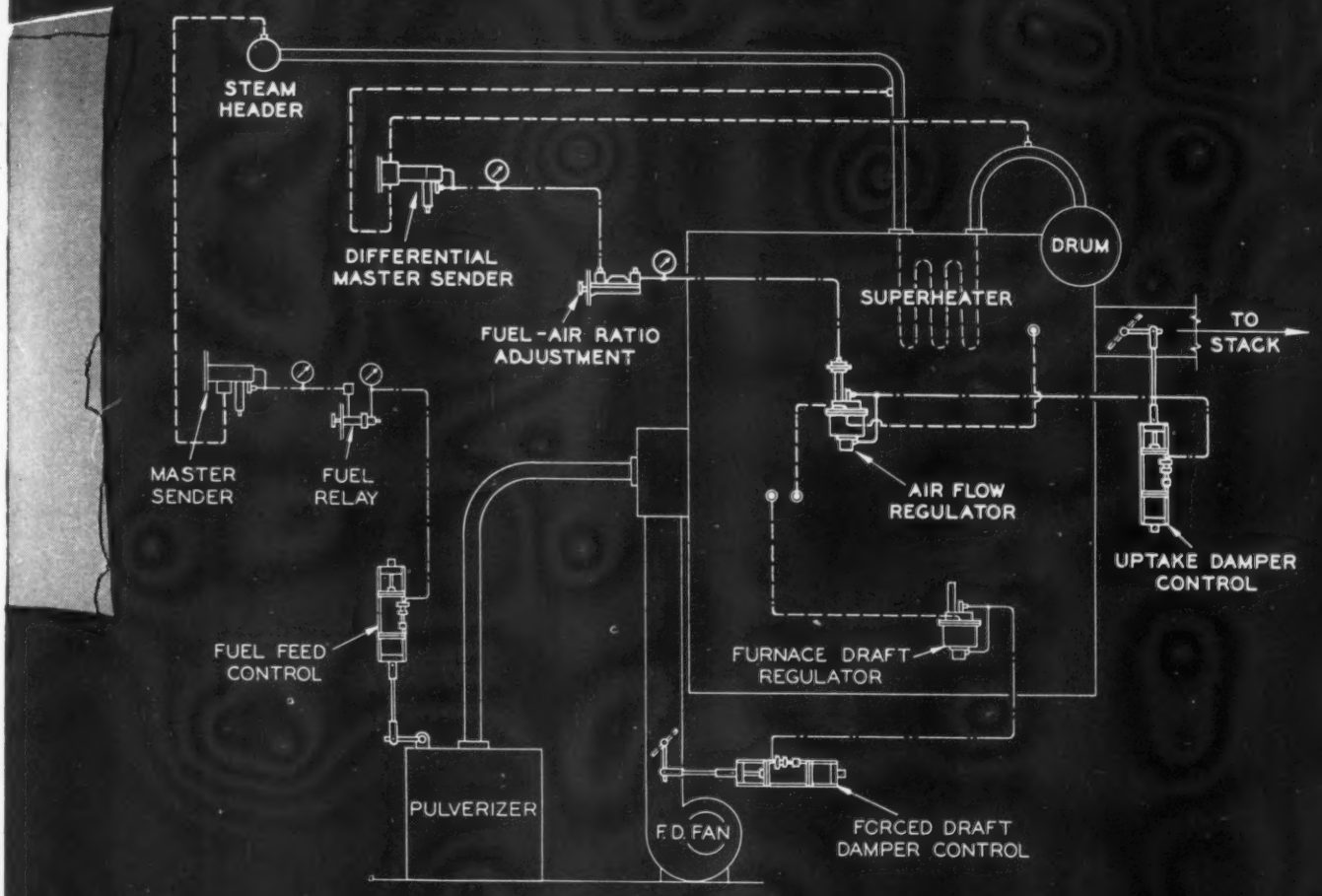
The Differential Master method has been thoroughly tested in service. In the past three years it has been applied to boilers burning oil, gas, and pulverized coal. Boiler sizes ranged from 30,000 lbs./hr. at 200 p.s.i. to 650,000 lbs./hr. at 1800 p.s.i. In every instance, results have been entirely satisfactory.

This development again emphasizes Hagan's continuing leadership in the field of automatic combustion control.

HAGAN CORPORATION, HAGAN BUILDING, PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

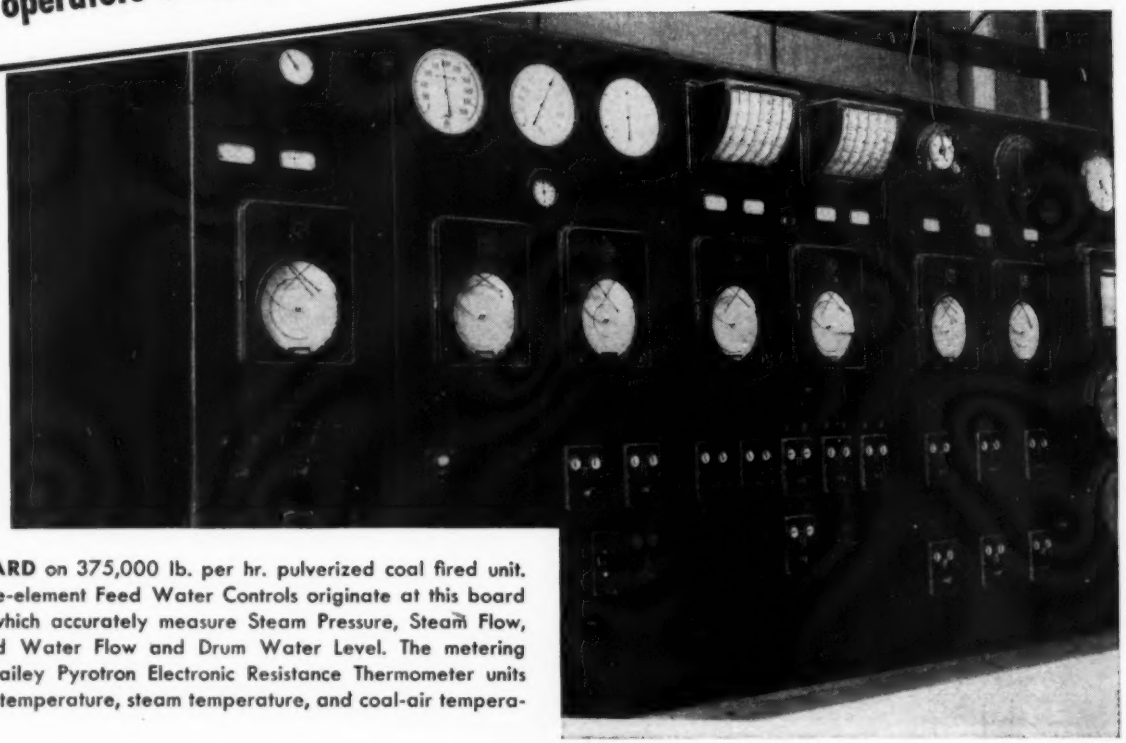
The pioneer . . . and still the leader



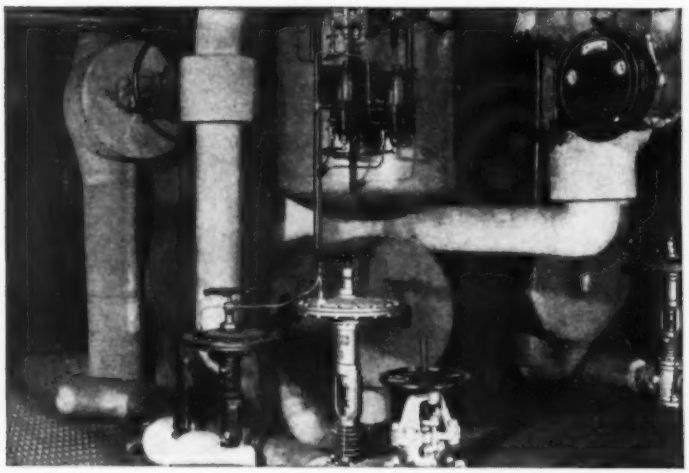
HAGAN
HALL
BUROMIN
CALGON

Dedicated to Optimum Steam Plant Performance

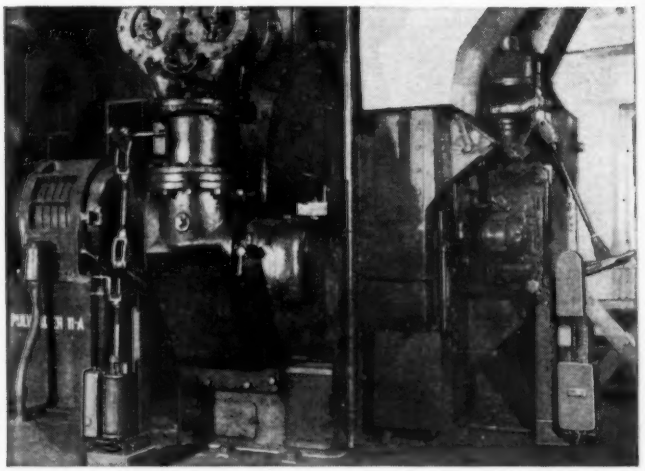
Bailey Controls at Williamsburg Station of Pennsylvania Edison Co. help operators to secure Safety, Economy and Continuity of Service



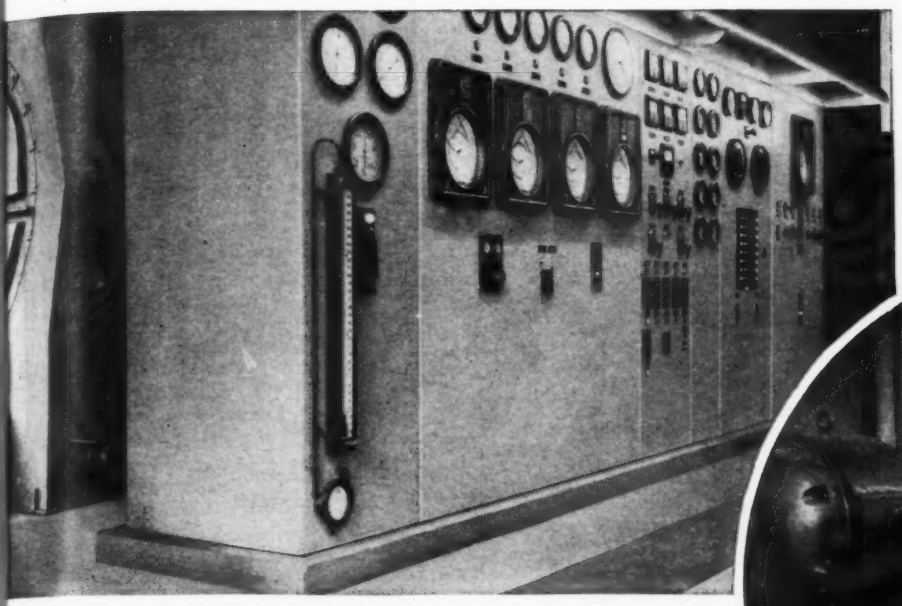
BAILEY BOILER BOARD on 375,000 lb. per hr. pulverized coal fired unit. Combustion and Three-element Feed Water Controls originate at this board from Bailey Meters which accurately measure Steam Pressure, Steam Flow, Air Flow, Draft, Feed Water Flow and Drum Water Level. The metering equipment includes Bailey Pyrotron Electronic Resistance Thermometer units to record feed water temperature, steam temperature, and coal-air temperature at each mill.



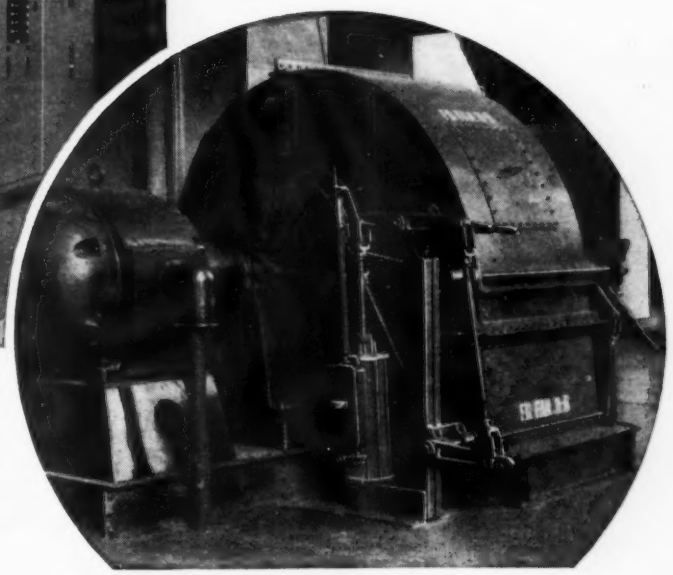
HEATER DRAIN CONTROL. Bailey Level Controller and relays regulate drain valves to maintain the desired high pressure drainer level.



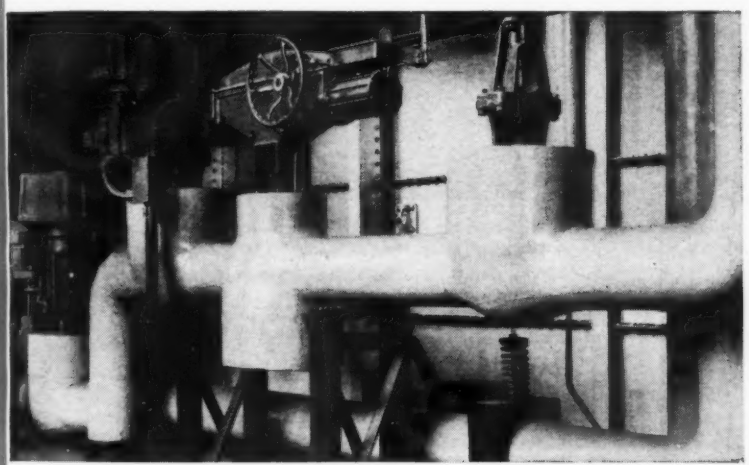
PULVERIZER CONTROL. These Bailey Control Drives regulate raw coal feed and coal-air output from a Riley Atrita Pulverizer in accordance with boiler load demand as measured by the Bailey Master Steam Pressure Controller.



TURBINE BOARD. A Bailey Three-element System of condensate control originates at this board from the first three recording meters which measure: (1) Total flow output from high pressure boiler feed pumps, (2) Condensate flow to No. 1 Heater, (3) Level in No. 3 Heater. The fourth meter records and integrates steam flow to the high pressure turbine and a fifth meter records pressure and temperature of desuperheated steam.

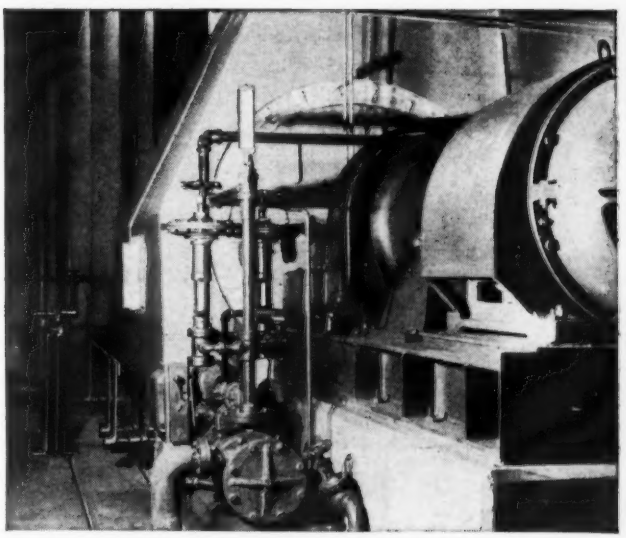


FORCED DRAFT FAN CONTROL. Bailey Control Drives position inlet vanes to supply air for combustion in accordance with the requirements established by the Master Steam Pressure Controller and the Bailey Boiler Meter.



BAILEY THREE-ELEMENT FEED WATER CONTROL VALVE. This powerful valve regulates feed water input to the boiler so that it equals steam output and maintains a safe drum level at all times. Control impulses originate from the accurate measurements of Bailey Meters on the Boiler Board.

All photos by the courtesy of Burns & Roe, Inc. For more information on coordinated Boiler Control Systems, such as installed at the Williamsburg Station, ask for Bulletin 15-C.



INDUCED DRAFT FAN CONTROL. Bailey Control Drive and Valves regulate the induced draft damper and the hydraulic coupling fan speed control to maintain the desired furnace draft.

A-96

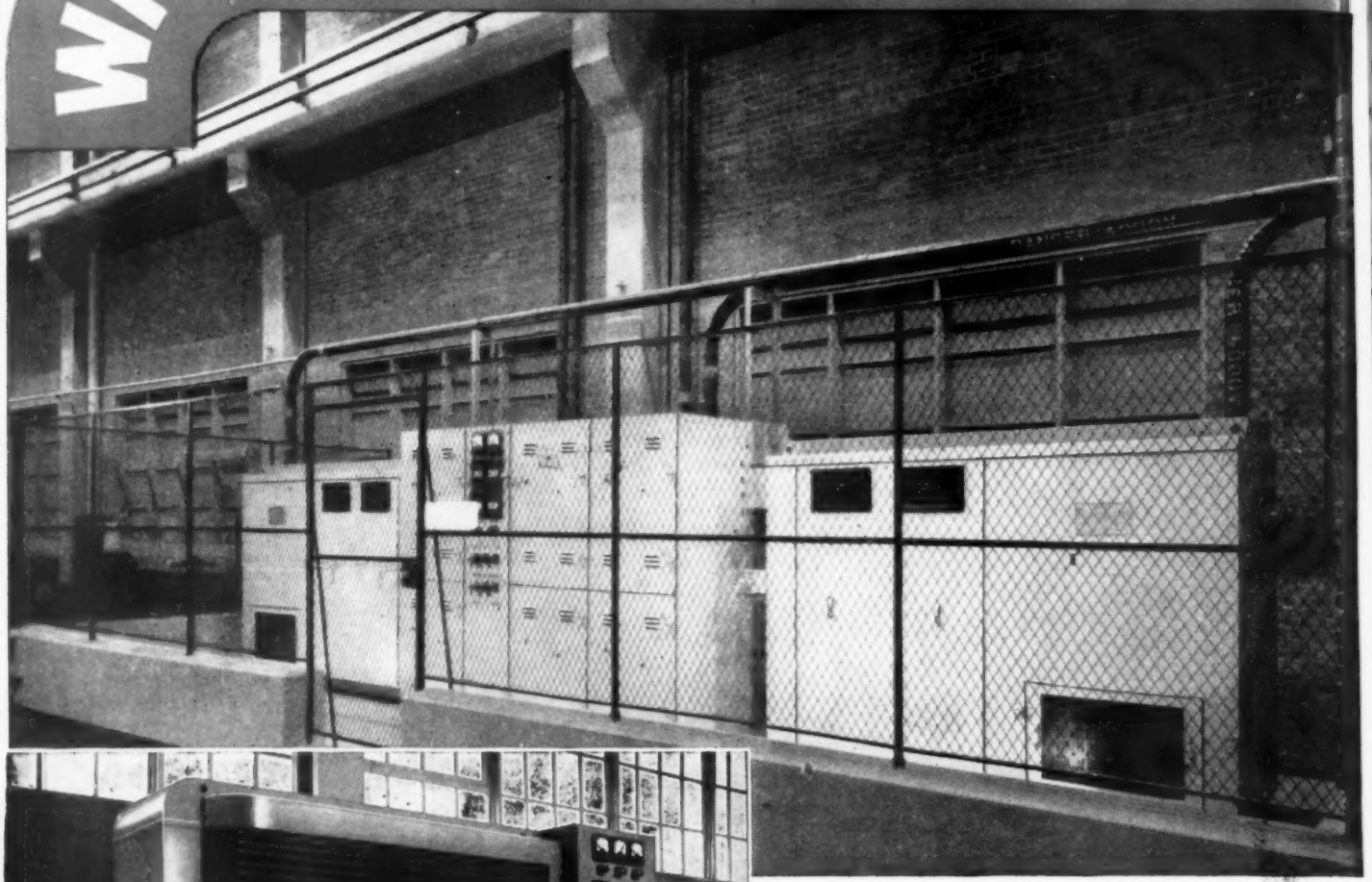
BAILEY METER COMPANY

1036 IVANHOE ROAD • • • CLEVELAND 10, OHIO

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Controls for Steam Plants

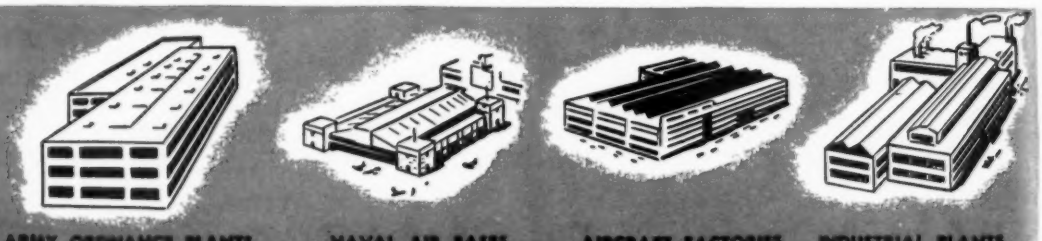
WHY G-E dry-type transformers



At a light-metals plant in Pittsburgh—This 2000-kva, 4160- to 480-volt unit substation is one of five such installations at this plant. (The enclosing fence is to prevent tampering with controls.) Compare the metal-enclosed construction of this dry-type equipment with conventional open-screen designs.

Good looks is a standard feature of all G-E dry-type, load-center unit substations. Such units are "naturals" for distribution revamping programs because, if you so desire, you can buy them one block at a time and still end up with a completely modern co-ordinated system—a system in which the self protection of each substation confines most troubles to a small area and prevents crippling plant outages. Available in ratings from 200 to 2000 kva, 601 to 15,000 volts.

DRY-TYPE TRANSFORMERS AND UNIT SUBSTATIONS



ARMY ORDNANCE PLANTS NAVAL AIR BASES AIRCRAFT FACTORIES INDUSTRIAL PLANTS

IN USE FROM COAST TO COAST

have won wide acceptance

1. These ultramodern, dry-type distribution transformers are designed to meet AIEE Standards No. 1 for Class B insulation, with 130 C maximum hot-spot temperature in a maximum ambient of 40 C. They also meet ASA Standards C-57.1, which limit the observable temperature rise to 80 C.

2. Because they meet industry standards for hot-spot temperature, G-E dry-type transformers are better suited to handle emergency overloads than units designed to higher temperatures. Longer life under severe service conditions is the inevitable result.

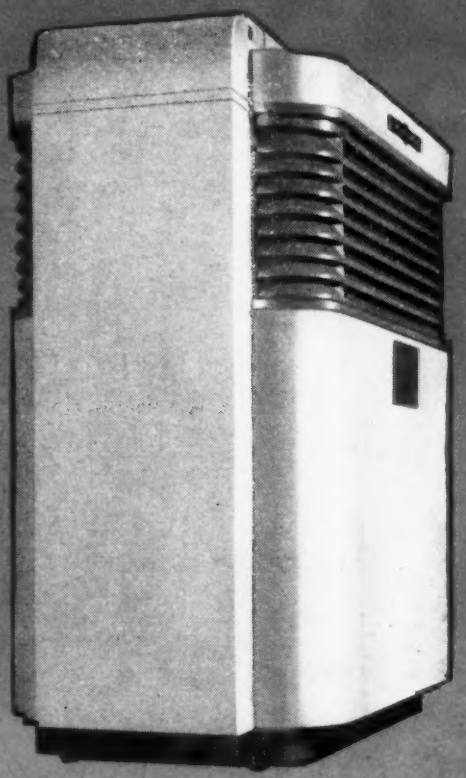
3. Housings are designed for utility, and are attractive in appearance.

4. Completely metal-enclosed construction prevents rods and wires from being accidentally pushed into the live parts.

5. There are no exposed live parts, such as bushings, that would lessen safety and make a fence mandatory.

6. Cable terminal compartments are completely removable, so the high-voltage and low-voltage cables can be made up and the unit slid into place between them without the use of a crane or elaborate hoisting and jacking facilities.

7. Transformer side plates are readily removable to facilitate inspection and cleaning of the core and coils.



Styled dry-type G-E distribution transformers are available for use on 601- to 15,000-volt primary circuits, in ratings from 100 to 2000 kva.

If you prefer dry-type designs, you will find these ultramodern dry-type transformers ideal for modernizing your plant's power system.

Their trim good looks, their safety, and ease of installation make dry-type units "at home" anywhere in your plant.

They fit right in with the economic good sense of *load-center power distribution*, which offers savings in installation cost, power, and assurance of full voltage at every lamp and machine.

When these transformers are a part of unit substations, the interrupting capacity of the substation switchgear section is exactly matched (electrically, mechanically, thermally) with the transformer capacity. It is adequate for even the most severe short circuits.

Ask for Bulletin GEA-3592A (load-center unit substations); Bulletin GEA-3714B (dry-type distribution transformers). *General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

BUY WAR BONDS

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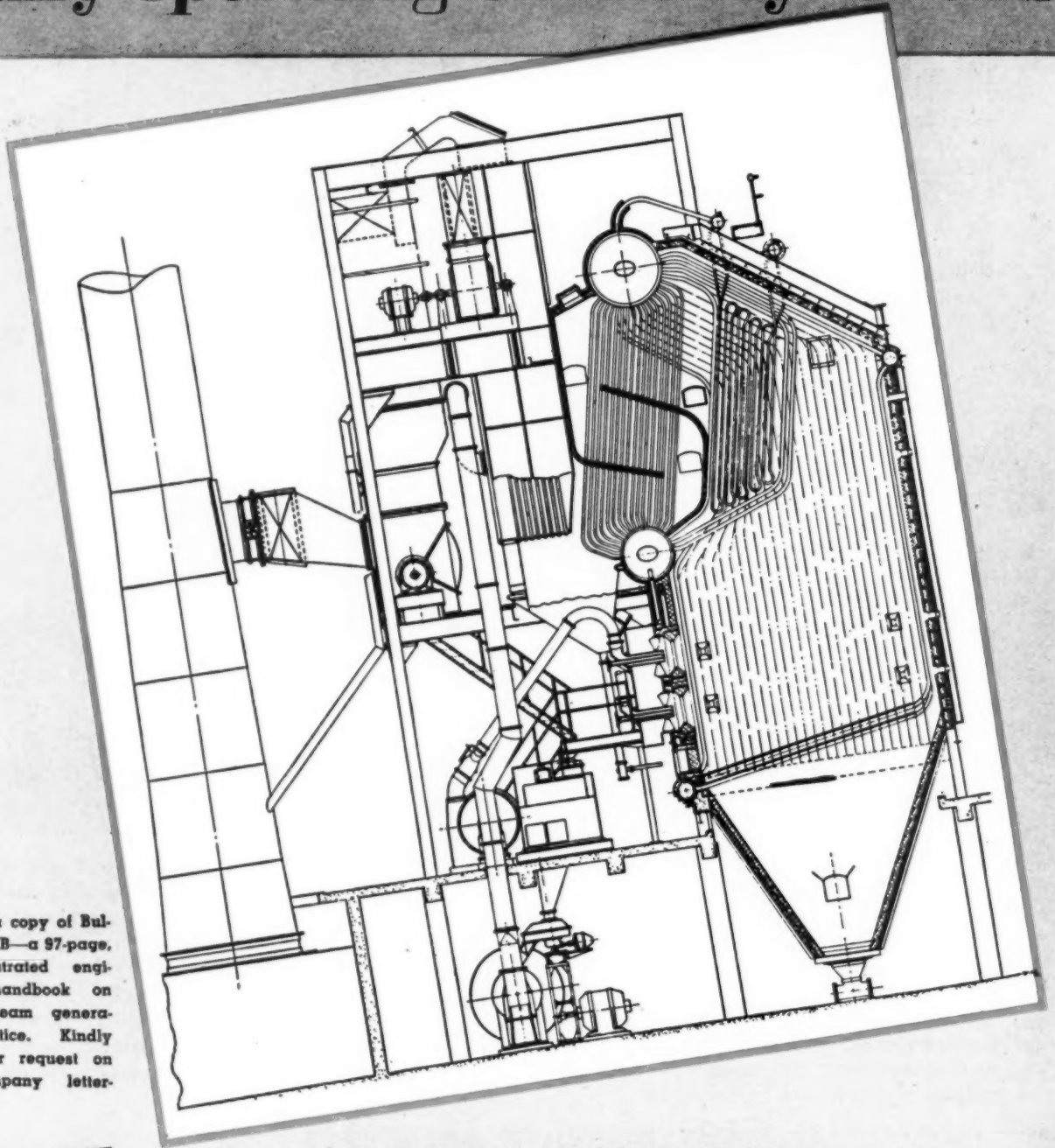
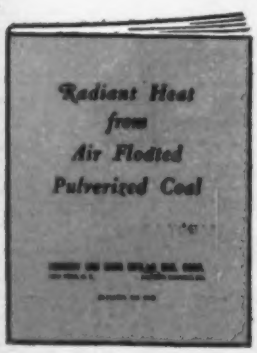
Daily operating efficiency—of this



Write for a copy of Bulletin No. 44B—a 97-page, fully illustrated engineering handbook on modern steam generation practice. Kindly make your request on your company letterhead.



K.V.S. EQUIPMENT IN THIS INSTALLATION

- STEAM GENERATOR
- WATER AND SHADOW WALLS
- SUPERHEATER
- ECONOMIZER
- AIR PREHEATER
- AIR SWEPT TUBE MILL
- HORIZONTAL MIXING TYPE BURNERS
- STEAM PURIFIER

●

K. V. S. Engineering Service is available to assist you in meeting your steam generating requirements.

KVS steam generating plant is...

88.0 Plus %

FEATURES AND OPERATING DATA

Plant Owner — American Colloid Division, E. F. Drew Company, Boonton, New Jersey.

Capacity Boiler — 60,000# steam per hour.

Operating Pressure—500 psi.

Steam Temperature—750° F.

Fuel — Bituminous Coal — 13,250 B.T.U. per lb., 9% ash.

Steam Purity—0.5 parts per million.

Operating Efficiency—88% plus.

Guaranteed Efficiency — 87.3%. (The operating efficiency over and above guarantee is due largely to superfine pulverization).

Firing—Pulverized Coal (or oil).

(Further details of this boiler will be found on p. 53 of K.V.S. Bulletin No. 44B, available on request).

This entire plant was designed and erected under one responsibility—K.V.S. Engineering Service.

Kennedy-Van Saun

MANUFACTURING AND ENGINEERING CORPORATION

2 PARK AVENUE • NEW YORK 16, N. Y.

FACTORIES. DANVILLE, PA.

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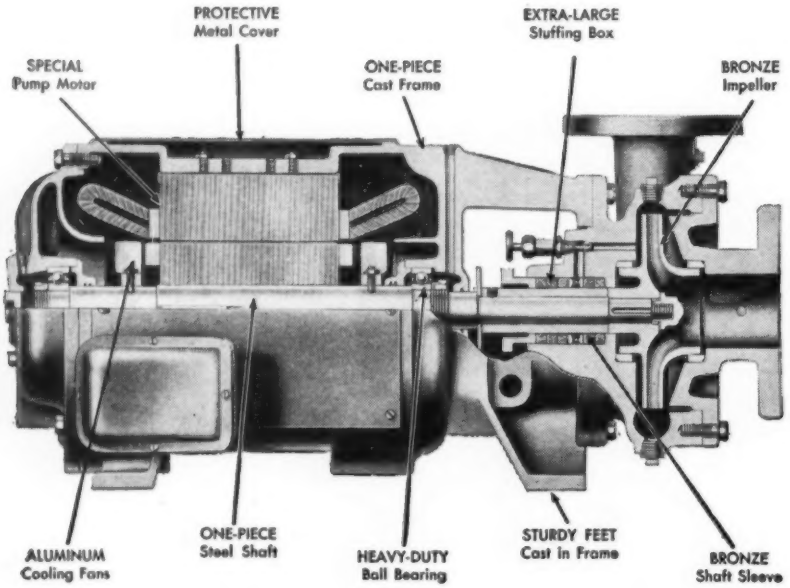
X-Ray View

Shows Why A-C's Smooth-Running Electrifugal Pump is the Finest of its Kind!

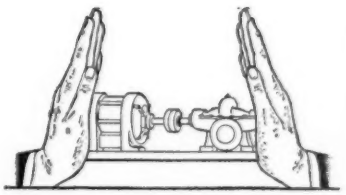


TOP QUALITY and extra value — that's what A-C's Electrifugal Pump gives you in terms of performance and economy! X-ray view above shows how Allis-Chalmers engineering has magically combined pump-and-motor into a single compact unit — which takes less space, gives you smooth operation with maximum protection against dangers of abnormal wear, leakage, corrosion, vibration! Consider these outstanding features: One-piece frame saves 33% in space; one shaft for pump-and-motor assures alignment; splash-proof motor is specially designed for pumping at low power cost. For further details on this great pump, call your nearby A-C office, or write ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

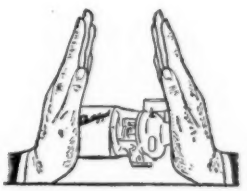
HEAR THE BOSTON SYMPHONY: *Saturday, American Broadcasting Co.*

A 1924

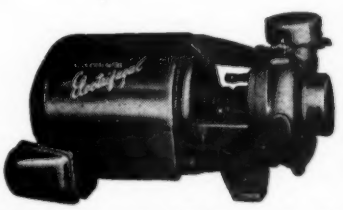
SQUEEZE PLAY CUTS SPACE 33%!



PROBLEM: Here is conventional pump and motor. How can we couple them together *better*—to save space, increase stability, and provide rigid alignment.

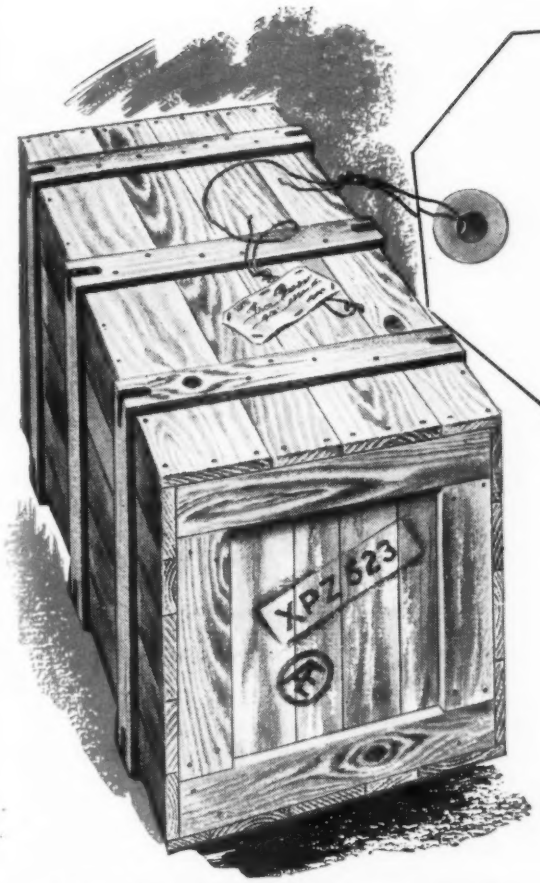


SOLUTION: We design a new kind of pumping unit—the one and only "Electrifugal" Pump! Motor and pump are now on one shaft—which cuts space 33%, assures alignment and smooth operation. No wonder "Electrifugals" give you more pumping power for your money!



SEA-BLUE BEAUTY: Modern design of Electrifugal Pump looks well on jobs anywhere! Capacities from 15 to 1600 gpm—heads up to 500 feet.

ALLIS-CHALMERS *Electrifugal* PUMPS



CONTENTS— ONE STOKER THAT WON'T CLOG!

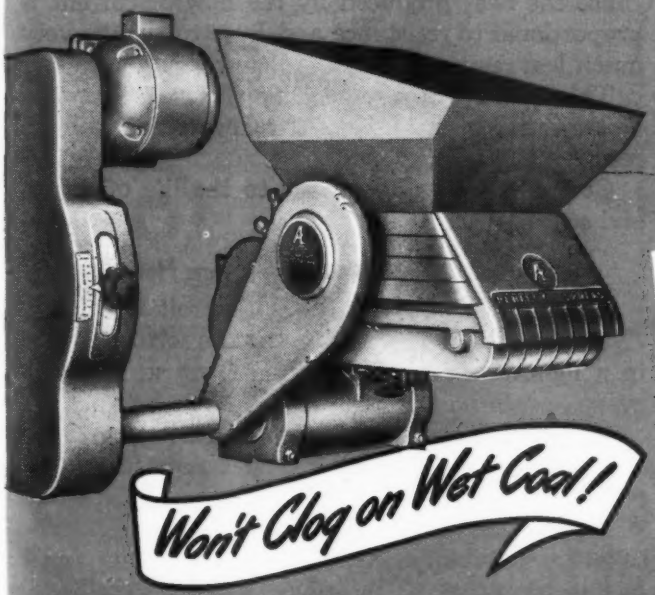
IT'S A FACT! The Æ Perfect Spread Stoker hasn't clogged yet. Even when your coal supply is wet or partially frozen, it feeds readily, *steadily*, through a foolproof mechanism to the reliable *overthrow* rotor that spreads a "perfect" fuel bed. Your fuel firing is *safe*guarded by the exclusive Æ non-clog feature, your steam costs reduced because you get more steam from the very lowest grades of coal and solid fuels.

Designed simplicity from hopper to grates and fully automatic operation from a *single* low cost power source brings you greater combustion efficiency and new freedom from fuel worries and maintenance problems. Send for the Æ Perfect Spread Stoker booklet and look into all the advantages to be gained by modernizing your boiler room *now—with the only non-clogging stoker of its kind!*

Æ

PERFECT SPREAD STOKER

WITH STATIONARY GRATES, DUMPING GRATES OR CONTINUOUS ASH DISCHARGE — UP TO 400,000 LBS. OF STEAM PER HR.



IT'S SEASONED IN *EXPERIENCE*

NEW IN PERFORMANCE!

The Perfect Spread Stoker has a record of proved economy—in 15 types of industries—over a 17 year period!

Other Æ Products: Æ-Taylor Stokers, Lo-Head Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

AMERICAN ENGINEERING COMPANY

2400 ARAMINGO AVE., PHILADELPHIA 25, PENNSYLVANIA

You can:

Reduce Heating

in Panels and Switches

Keep circuits operating – Prevent costly shutdowns *by installing* FUSETRONS

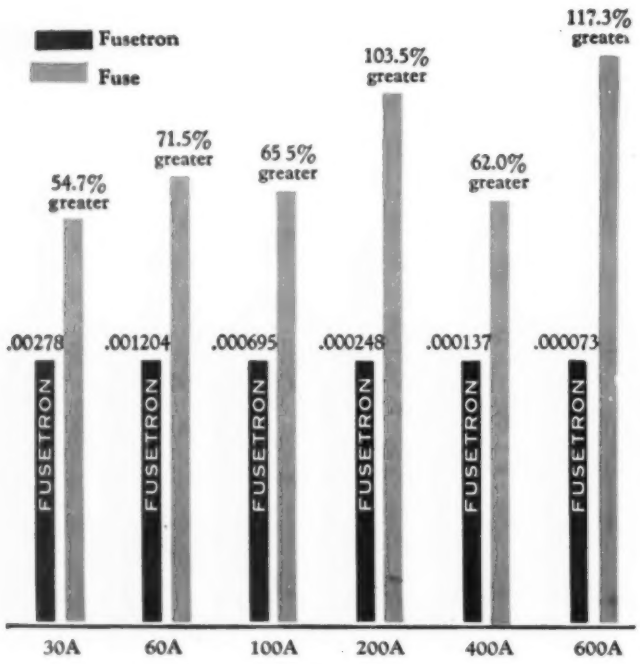
Fuses, like all other protective devices, operate from heat created by the current flowing through them. Thus they produce some heat even in normal operation.

This heat must be dissipated from switches and panels through the air, through metal parts and through the wires connected to such enclosures.

Sometimes the heat is not dissipated fast enough—so it piles up in switches or panels.

This piled up heat over-heats fuses and reduces their carrying capacity. Then fuses often blow even though not loaded to their rated capacity.

LOOK AT THE RESISTANCE OF FUSETRONS COMPARED TO THE LOWEST RESISTANCE FUSE



Resistance shown at full load in ohms. Chart shows 250 volt sizes. 600 volt sizes show similar results.

To solve the heating problem by putting in larger metal parts or wires to conduct heat away faster is always costly. A more logical answer is to cut down heat at its source by using Fusetrons—they produce less heat because they have less electrical resistance than ordinary fuses.

Cooler Operation of Switches and Panels Reduces Needless Blowing of Fuses

Install Fusetrons in your switches and panels and they will operate much cooler than with fuses because the heat produced by the flow of current is proportional to resistance and Fusetrons have very much less resistance than ordinary fuses.

This cooler operation means the elimination of needless blows and useless shutdowns that are the result of heating in fuses.

Cooler operation also adds to the life of panels and switches.

Here's PROOF Fusetrons Reduce Heating

Says an executive of a large Detroit Company. (Name on request.) "One-time fuses formerly used in a lighting circuit feeder panel got so hot that every fuse burned itself up and had to be replaced every month. Our Chief Electrician changed the fuses to Fusetrons of the same size. After three months, only one circuit had opened and the panel was very much cooler than it had been with one-time fuses. Subsequently we changed all our fuses to Fusetrons."

BUSS

Fusetrons do everything fuses do. They open on harmful overloads and on short-circuits stop the flow of current quickly and safely, all of which is confirmed by the Underwriters' Laboratories Label . . . and in addition you can

Get many kinds of protection, *heretofore not available* – *by installing* FUSETRONS throughout the entire electrical system

★ ***Entirely wipe out needless blows caused by motor starting currents or other harmless overloads.***

Fusetrons have tremendous time-lag. They hold 500% load more than 10 seconds whereas most sizes of ordinary fuses blow in less than one second. They won't open on starting currents or harmless overloads (heavy overloads for a short time or light overloads for a longer time). Fusetrons won't shut down a circuit needlessly. They open only when something goes wrong.

★ ***Give Thermal Protection to Panelboards and Switches***

The thermal cutout in the Fusetron will open whenever its temperature reaches 280° F. Thus if poor contact heat develops from any cause the Fusetron cuts off the current before damaging temperatures can be reached.

Ordinary fuses can't so protect because the temperature of the link must reach 786° F. before it will melt out.

With Fusetrons you are warned that a minor maintenance job is needed instead of having panel or switch damaged or destroyed by poor contact.

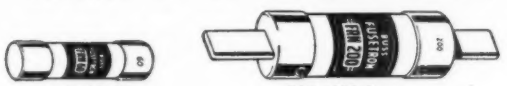
★ ***Prevent Needless Blows caused by Heating in Panels and Switches***

(*See Opposite Page*).

★ ***Permit use of larger motor or adding more motors on circuit WITHOUT installing larger switch or panel***

The operating load on Fusetrons can be close to their ampere rating because Fusetrons hold starting currents. But ordinary fuses must be installed oversize because they lack sufficient time-lag to hold starting currents.

WHAT IS THE FUSETRON?



0 to 60 Amp. 70 to 600 Amp.

The Fusetron is a DUAL element device — A Fuse to which is added a Thermal Cutout.

The result is a fuse with tremendous time-lag and much less electrical resistance.

Fusetrons have the same degree of Underwriters' Laboratories' approval for both motor-running and circuit-protection as the most expensive devices made.

Fit standard fuse blocks

Fusetrons are made to same dimensions as ordinary fuses and fit all standard fuse holders.

They are obtainable in all sizes from 1/10 to 600 ampere—in both 250 and 600 volt types.

Also obtainable in plug type and Tamper-resisting type (Fustats) for 125 volt circuits.

Their Cost is Surprisingly Low

By replacing oversize fuses with Fusetrons, you can load panels or switches near their capacity. A larger motor or additional motors can be installed without the trouble or expense of changing the panel or switch.

★ ***On new installations, PROPER size switches and panels can be used instead of OVERSIZE***

With ordinary fuses, switches and panels must be oversize because fuses larger than the operating load must be used to hold starting currents.

But Fusetrons hold starting currents, therefore, PROPER size switches and panels to fit the load can be installed, saving money and space.

★ ***Protect motors against burnout***

On normal installations, Fusetrons used in a size near ampere rating of motor will protect it against burnout from lack of oil, worn bearings, tight belt or anything that causes a dangerous electrical overload—yet their tremendous time-lag keeps them from blowing on motor-starting current.

★ ***Give DOUBLE burnout protection to large motors.***

Larger motors already equipped with overload protection sometimes burn out due to thermals or relays failing to operate. Replace fuses used for short-circuit protection with Fusetrons of size near motor rating and they will protect motor against burnout from any electrical overload, entirely independent of other overload device.

★ ***Provide simplest way to stop burnouts from single phasing***

When single phasing occurs, increased current flowing through remaining phase will open Fusetrons (if size used is near the rating of the motor) and shut down motor. Never before has such dependable single phasing protection been available.

★ ***Make burnout protection of SMALL motors simple and inexpensive***

Small motors have generally been operated without burnout protection because the cost of protecting them has been too great compared to cost of replacing motor. Now for the little cost of installing a Fusetron of proper size, any motor can be given safe, dependable burnout protection.

★ ***Protect Coils, Transformers and Solenoids against burnout***

Install a proper size Fusetron. It won't open on harmless overloads of normal current surges, yet should a dangerous overload occur for any reason it will cut off the current to prevent a burnout.

ACT ON THE FACTS; Even one needless shutdown or one lost motor or one destroyed panel may cost you more than replacing every fuse with a Fusetron. Don't risk such losses, change over the whole plant to Fusetrons at once.

FUSETRONS

GET THE FACTS — *CHECK THE COST*

148

BUSSMANN MFG. Co., University at Jefferson, St. Louis 7, Mo. (*Division McGraw Electric Co.*)

Please send me complete facts about BUSS Fusetrons.

Name_____

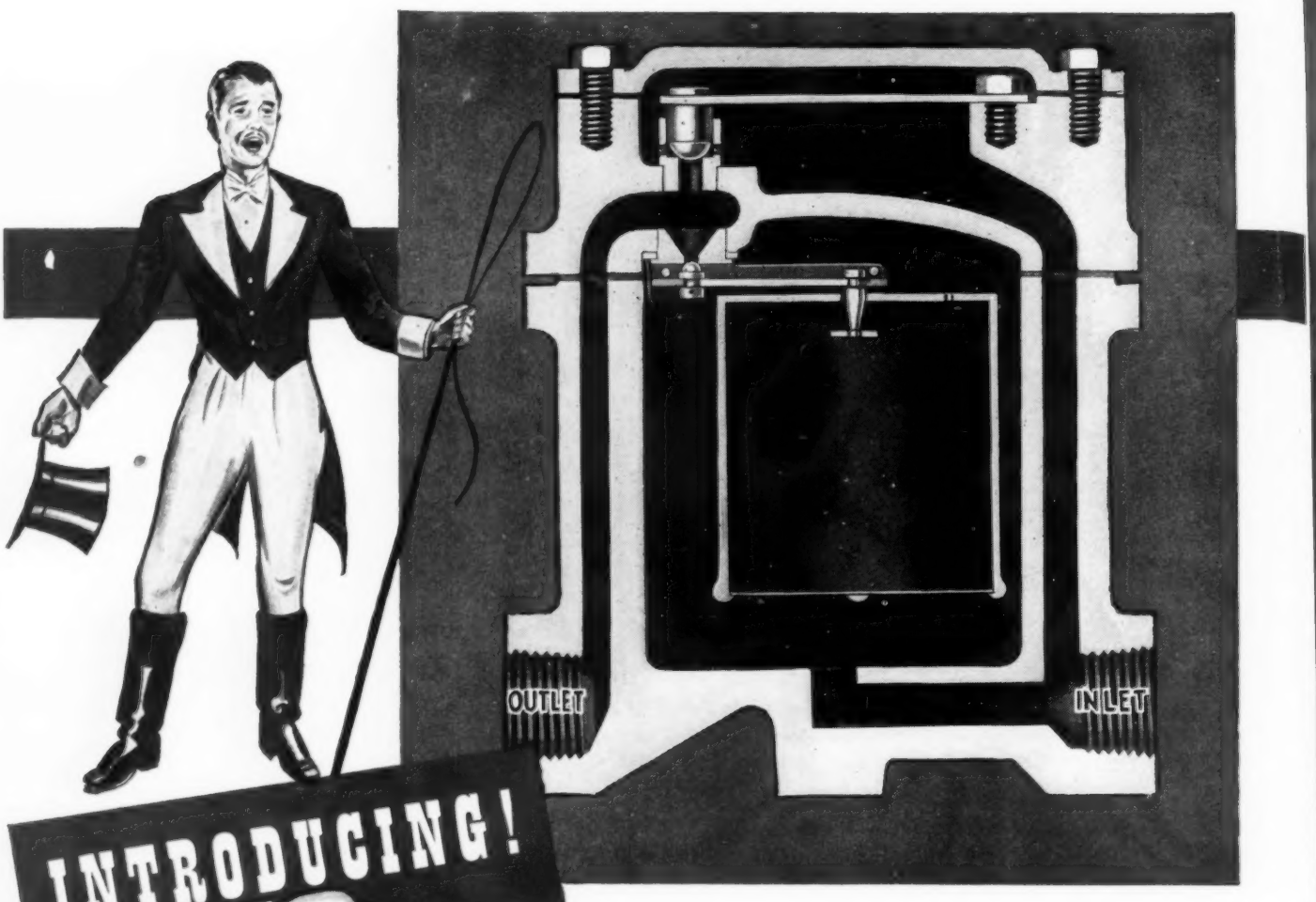
Title_____

Company_____

Address_____

City_____ State_____

P



INTRODUCING!

Series 70-T STEAM TRAPS

COMBINATION INVERTED BUCKET AND BLAST TYPE

For use on or with

AUTOCLAVES • PRESS PLATENS • PIPE COILS • TIRE MOLDS
LAUNDRY EQUIPMENT • UNIT HEATERS, ETC.

Suitable for working pressures to 150 P.S.I. and temperatures to 375°F. inlet and outlet connections—½", ¾" or 1" I.P.S. Special small traps with built-in thermal bypass to rapidly bring system up to operating temperature by fast elimination of air and condensate. Continuous flow capacities up to 2600 lbs. per hour (plus flow through Thermal Bypass) according to size, seat orifice and trap differential pressure. Trap furnished with various size main discharge valve seat orifices that will operate at any pressure below and up to the following Pressure Ratings: 10, 30, 50, 75, 125, or 150 lbs. as specified. Thermal Bypass furnished with disc and seat in one of the following Pressure Ratings: 0 to 30 lbs., or 30 to 150 lbs.

Clark

FLUID CONTROLS

Clark
FLUID CONTROLS

DESIGN FEATURES OF SERIES 70-T STEAM TRAPS

★ **POSITIVE INTERMITTENT TRAP ACTION**

★ **STRAIGHT-IN-LINE** inlet and outlet connections.

★ **UNRESTRICTED CONDENSATE FLOW** assured by generous ports and passages.

★ **READILY ACCESSIBLE WORKING PARTS** attached to cover—no pipe connections to break.

★ **DEPENDABLE OPERATION** assured through use of Clark long life ball type discs and seats. Made of "Clarkloy." Tight seating made certain by precision lapping.

★ **DURABLE and POSITIVE OPERATING LEVERAGE**

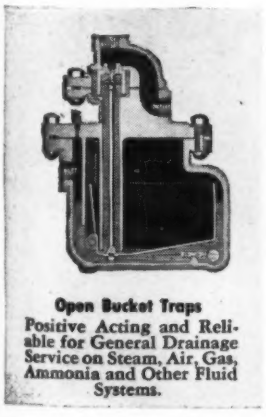
★ **CLARK AUTOMATIC THERMAL BYPASS,** which

- ★ Operates entirely independent of the main discharge valve.
- ★ Increases the rate of air discharge. This feature is particularly important for installations requiring extra initial air elimination for rapid heating.
- ★ Discharges condensate rapidly at starting (peak) load when pressure differential is low.
- ★ Closes automatically when the condensate reaches a temperature of approximately 210°F., thus preventing loss of steam.
- ★ Opens automatically should the condensate temperature drop below 200°F.

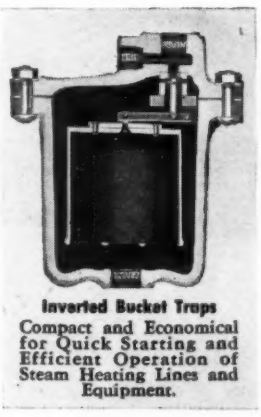
★ **THERMAL BYPASS ELEMENT** (Bimetallic Strip) is positive in action, simple responsive. Made of special, bonded, non-corrosive alloys having high tensile strength. Easily accessible for inspection by simply removing screws in top plate, pipe connections remaining undisturbed.

★ **THERMAL DISC AND SEAT**—Made of "Clarkloy." Ball type disc moves in seat guide which is provided with generous discharge passages for rapid elimination of air and condensate.

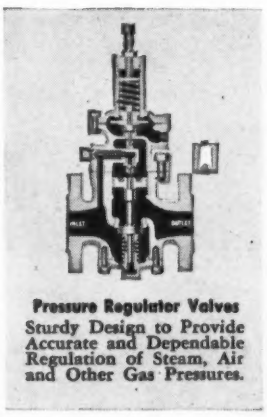
WRITE FOR FREE CATALOG SHOWING COMPLETE LINE OF CLARK FLUID CONTROLS



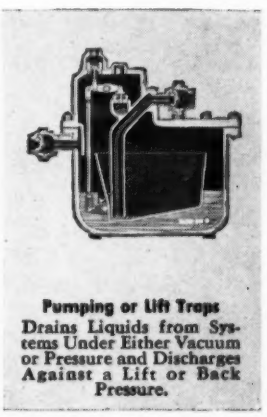
Open Bucket Traps
Positive Acting and Reliable for General Drainage Service on Steam, Air, Gas, Ammonia and Other Fluid Systems.



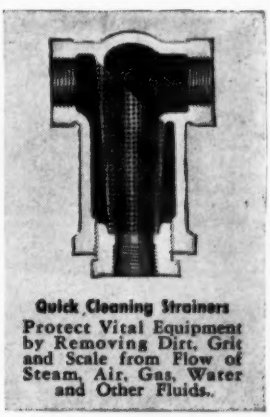
Inverted Bucket Traps
Compact and Economical for Quick Starting and Efficient Operation of Steam Heating Lines and Equipment.



Pressure Regulator Valves
Sturdy Design to Provide Accurate and Dependable Regulation of Steam, Air and Other Gas Pressures.



Pumping or Lift Traps
Drains Liquids from Systems Under Either Vacuum or Pressure and Discharges Against a Lift or Back Pressure.



Quick Cleaning Strainers
Protect Vital Equipment by Removing Dirt, Grit and Scale from Flow of Steam, Air, Gas, Water and Other Fluids.

THE CLARK MANUFACTURING CO. · Cleveland 14, Ohio

WESTERN CANADIAN DIST.
MOORE DRY KILN COMPANY OF CANADA, LIMITED
VANCOUVER, BRITISH COLUMBIA

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LYTLE ENGINEERING SPECIALTIES, LIMITED
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FOR OVER 37 YEARS MANUFACTURERS OF HIGHEST QUALITY STEAM TRAPS

NOW! You Can Specify

For Parts That Must Be Strong

...SIMPLE or INTRICATE DESIGNS

...SMALL or MASS-PRODUCTION QUANTITIES

Proved by Experience

HAYNES Precision Casting techniques were first perfected in the production of millions of aircraft turbosupercharger buckets—to rigid A.A.F. specifications. Precision casting (known sometimes as "investment casting" or "the lost wax process") has since proved its worth for key parts of gas and steam turbines, jet-propulsion planes, and a variety of mechanical parts subjected to the toughest service. Now we can offer you the benefits of our experience and extensive production and development facilities.

HAYNES Precision Castings

TRADE-MARK

Hard and Corrosion-Resistant, Even At High Temperatures

HAYNES PRECISION CASTINGS OFFER THESE DEMONSTRATED ADVANTAGES

Quality Alloys having an unusual combination of properties can be readily precision-cast. HAYNES Precision Castings are available in HAYNES STELLITE, HASTELLOY, HASCROME, and various grades of stainless steels . . . alloys exhibiting exceptional strength, hardness, and corrosion resistance even at high temperatures.

Close Tolerances, plus or minus 0.003 in. on small castings, are attainable. Closer tolerances or thinner edges than can be economically cast are available with a minimum of finishing.

Good Metallurgical Properties and sound castings result from the HAYNES precision casting process.

Intricate Shapes, Contours, and thin edges, such as the air-foil sections of gas-turbine parts, are consistently reproduced. Internal and external threads, shoulders, and cored holes (including odd-shaped cavities and recesses), and decorative surface designs can be produced.

Smoother, Cleaner Surfaces are possible than those generally obtained from other types of casting.

Improved Designs result because parts can be engineered for performance rather than for convenience of fabrication. The alloys available as HAYNES Precision Castings offer unusual engineering properties.

Mass Production by Haynes Precision Casting makes it possible to specify quality alloys for parts that will be required in large quantities and in shapes difficult to obtain by other methods of manufacture at reasonable prices.

The trade-marks "HAYNES," "STELLITE," "HASCROME" and "HASTELLOY" distinguish products of Haynes Stellite Company.

TWO NEW BOOKLETS DESCRIBE HAYNES PRECISION CASTING

If you would like to read more about HAYNES Precision Castings, send for these two booklets: F-6244 "HAYNES Precision Castings" and F-6320 "Supercharger Buckets Produced by Precision Casting."

HAYNES TRADE-MARK *alloys*

HAYNES STELLITE COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Ind.

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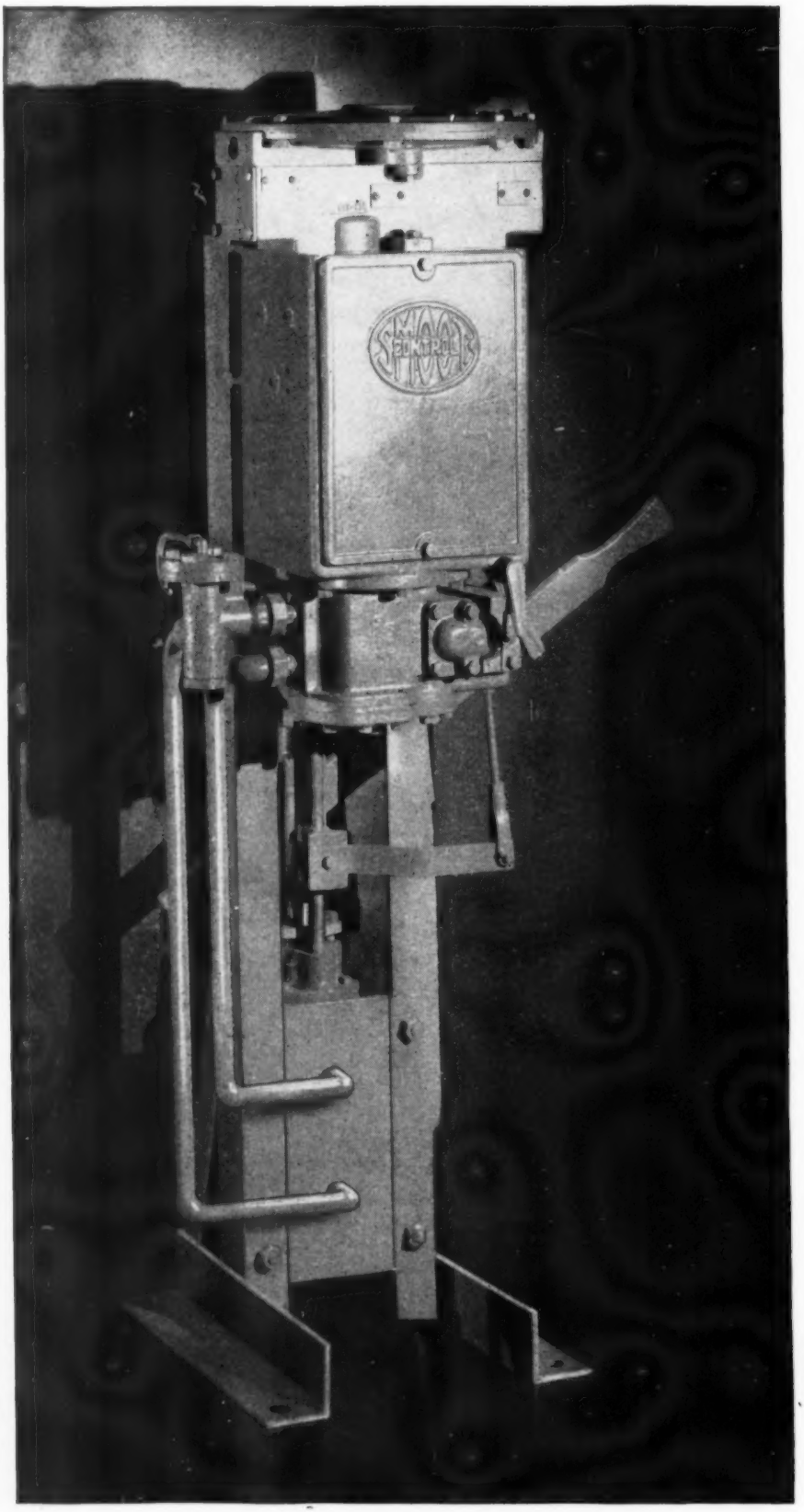
The Trend is to...



REPUBLIC REGULATOR APPLICATIONS

Pressure Control

Steam pressure control
Boiler furnace draft
Primary air pressure
Feed water pressure
Evaporator pressure
Process steam pressure
Blast air pressure
Exhauster suction
Fuel gas pressure
Suction main pressure
Excess pressure

Flow Control

Water flow to desuperheaters
Water flow to condensers
Oil flow to boilers and furnaces
Gas flow to boilers and furnaces
Air flow to gas producers
Pump bypass

Level Control

Hot well levels
Surge tank levels
Storage tank levels
Evaporator levels
Boiler water levels

Speed Control

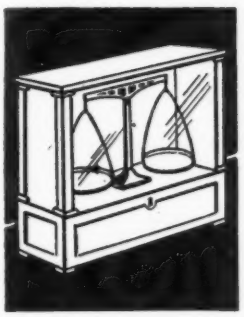
Stoker and fuel feeder speeds
Pulverizer speed
Pump speed
Fan speed
Steam turbine speed
Steam engine speed
Variable speed motors
Variable speed transmissions

View of a Republic hydraulic type regulator for controlling boiler air flow, mounted on stand with power cylinder.

REPUBLIC
INSTRUMENTS
AND CONTROLS

REPUBLIC Regulators

Because They Meet These Four Essentials of Good Regulation



Republic Regulators can be made sensitive to changes of less than 0.002 of an inch of water.

SENSITIVITY

The amount of change that is required in the quantity being controlled to effect the regulator is the measure of its sensitivity. For close, accurate regulation, a regulator must be sensitive. It must respond immediately to the slightest deviation from the predetermined setting or the controlled quantity may vary far beyond the permissible limits.

Republic Regulators will meet any speed requirement up to one full stroke in 2 seconds.

SPEED

The speed at which a regulator operates is an important factor in any control system. Any time lag between the variations in the controlled quantity and the operation of the control device to correct this variation, will produce an unnecessary error in regulation. A regulator, therefore, must be fast enough to follow the fastest load fluctuation.

Republic power cylinders are available to meet the specific power requirements of any particular installation.

POWER

A regulator must have sufficient power to not only operate the valve or other control device, but also to overcome any accidental friction or sticking that may occur in any part of the system. Insufficient power will cause failure in operation. It is for this reason that regulators are made with different size power cylinders, the smaller sizes being used for small valves and the larger sizes for the larger dampers and louvers.

The Republic stabilizer will stabilize against any time lag in the operation of the equipment being controlled.

STABILITY

Stability refers to the ability of a regulator to maintain its balanced position or to return immediately to a balanced position if the controlled quantity is disturbed. There is always an interval between the time the valve or other control device is moved and the time the controlled quantity changes in response to this movement. Unless a regulator is stabilized it will tend to "hunt" or overtravel causing unnecessary variations.

Write for Data Book No. S-13

Republic Flow Meters Co.

2222 Diversey Parkway • Chicago 47, Illinois

POWER INCREASED
FUEL SAVED
MAINTENANCE REDUCED

...with

EFFECTIVE DIESEL LUBRICATION

TEXACO Ursa Oils do more than just an outstanding job of lubricating—*they keep Diesel engines clean!* This means they prevent varnish and sludge. Rings stay free and valves active. Pistons provide proper seal for full compression. *Ursa Oils* also prevent scuffing, greatly reduce wear and have special properties to prolong the life of bearings, liners, rings and pistons. You can depend on trouble-free operation, lower maintenance costs.

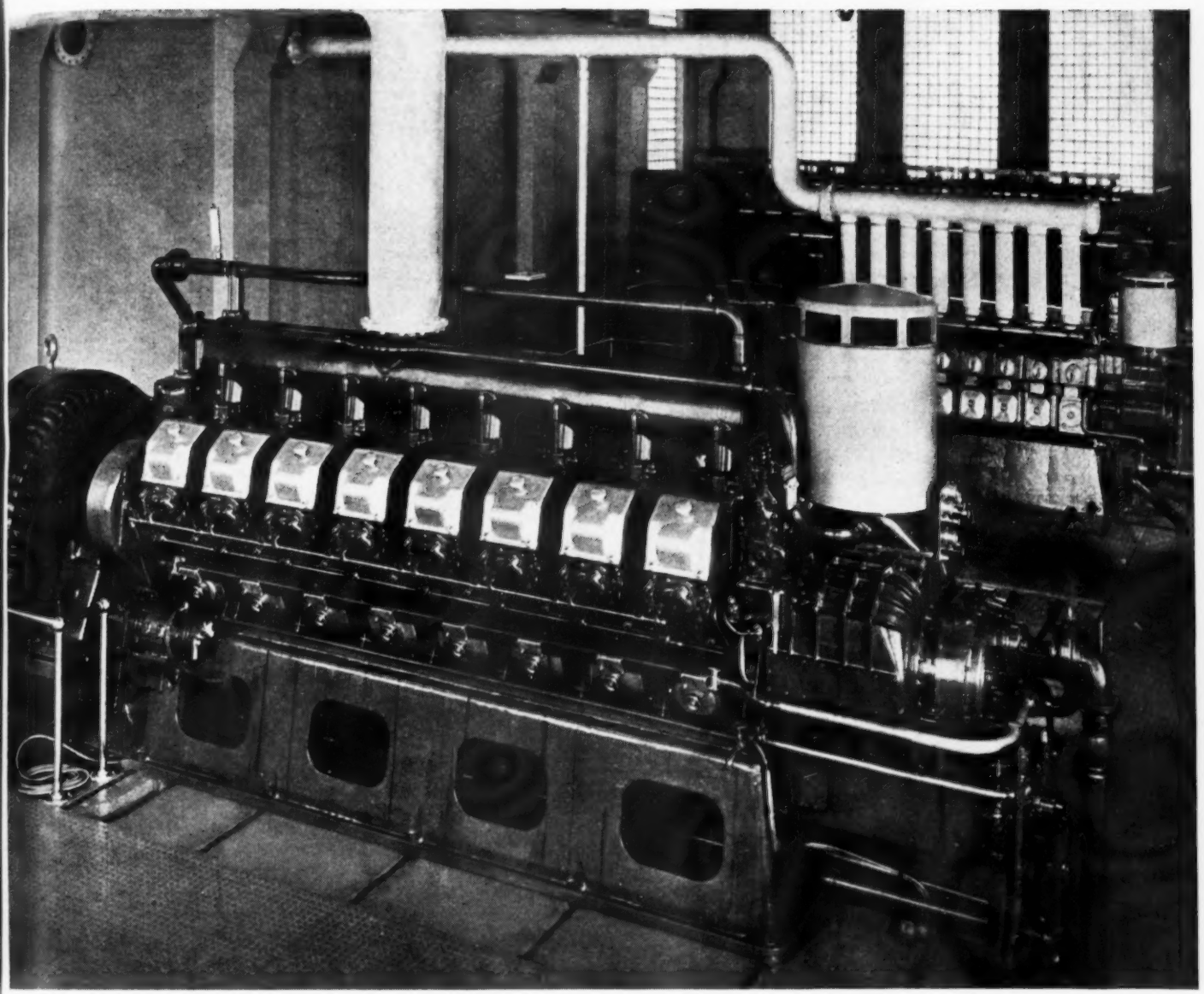
Today's *Texaco Ursa Oils* embody improvements developed by The Texas Company's steady research to assure ever-finer Diesel lubricants. They are processed by Texaco's own methods in one of the world's largest and most modern refineries. Skilled technicians supervise production from well to finished product to make sure of absolutely uniform quality.

On the basis of *performance*—all leading Diesel engine manufacturers approve *Texaco Ursa Oils,* and—

TEXACO

TEXACO

TUNE IN THE TEXACO STAR THEATRE WITH JAMES MELTON SUNDAY NIGHTS



More stationary Diesel hp. in the U. S. is lubricated with Texaco than with any other brand.

Let Texaco Lubrication Engineering Service help you obtain the most efficient and economical operation from *your* Diesels. Just contact the nearest of more than 2300 Texaco distributing plants in the 48 States, or write:

☆ ☆ ☆

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

FOR EVERY TYPE OF DIESEL

Effective lubrication of a Diesel engine calls for an oil especially designed for the particular type of engine and the service for which the engine is built. To meet this requirement, The Texas Company, in step with improvements in Diesel engine design over the past thirty years, has developed *a complete line* of Texaco Ursa Oils...one to meet the requirements of every type and size of Diesel, from the smallest high-speed portables to the largest stationary and marine installations. When a Texaco Lubrication Engineer recommends a particular grade of Ursa, you can be sure it is the *right* oil for maximum efficiency and minimum fuel consumption.

URSA OILS

FOR ALL DIESEL ENGINES

METROPOLITAN OPERA BROADCASTS SATURDAY AFTERNOONS

MORE ABOUT THE

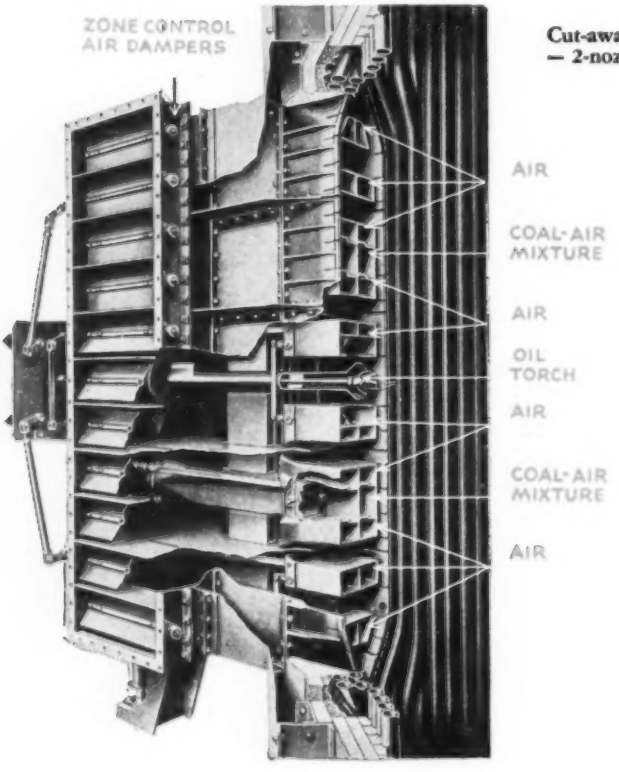
HOW IT WORKS

The key to the *adjustable furnace* is the C-E Vertically Adjustable Tangential Burner which, while somewhat complex in appearance, is quite simple in its method of operation.

The particular burner illustrated below has two pulverized coal nozzles, each of which has integral, secondary-air outlets above and below the coal-air mixture outlets in the center of the nozzle. In addition, each coal nozzle has its supplementary air nozzles above and below it. All of these nozzles are vertically adjustable by means of actuating levers which are brought out to a master operating lever outside the burner. The position of the burners is under remote control from a centrally located panel board. Each burner is provided with a built-in oil lighting torch equipped for electrical ignition.

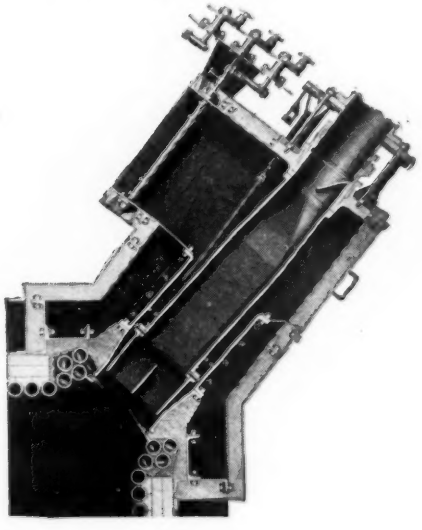
The coal-air and secondary air nozzles are all vertically adjustable through a total angle of 60 degrees, i.e. 30 degrees above and below the normal horizontal axis. Obviously by the simple expedient of moving these nozzles through this arc the position of the flame body in the furnace is brought under complete control of the operator.

By this means, more — or less — of the heat absorbing surfaces can be utilized at will with the result that gas temperatures in the upper furnace, and entering the first boiler pass and superheater, are under control of the operator.



Cut-away view of Adjustable Tangential Burner — 2-nozzle type.

Plan view at one corner of furnace. Burner in each corner fires tangentially to an imaginary circle in the center of the furnace, creating maximum turbulence.



Diagrams showing how coal nozzles may be tilted to control position of flame body in furnace.

Adjustable FURNACE

WHAT IT DOES

Combustion Engineering's "Vertically Adjustable Tangential Burners", functioning as described on the opposite page achieve two very important operating advantages:

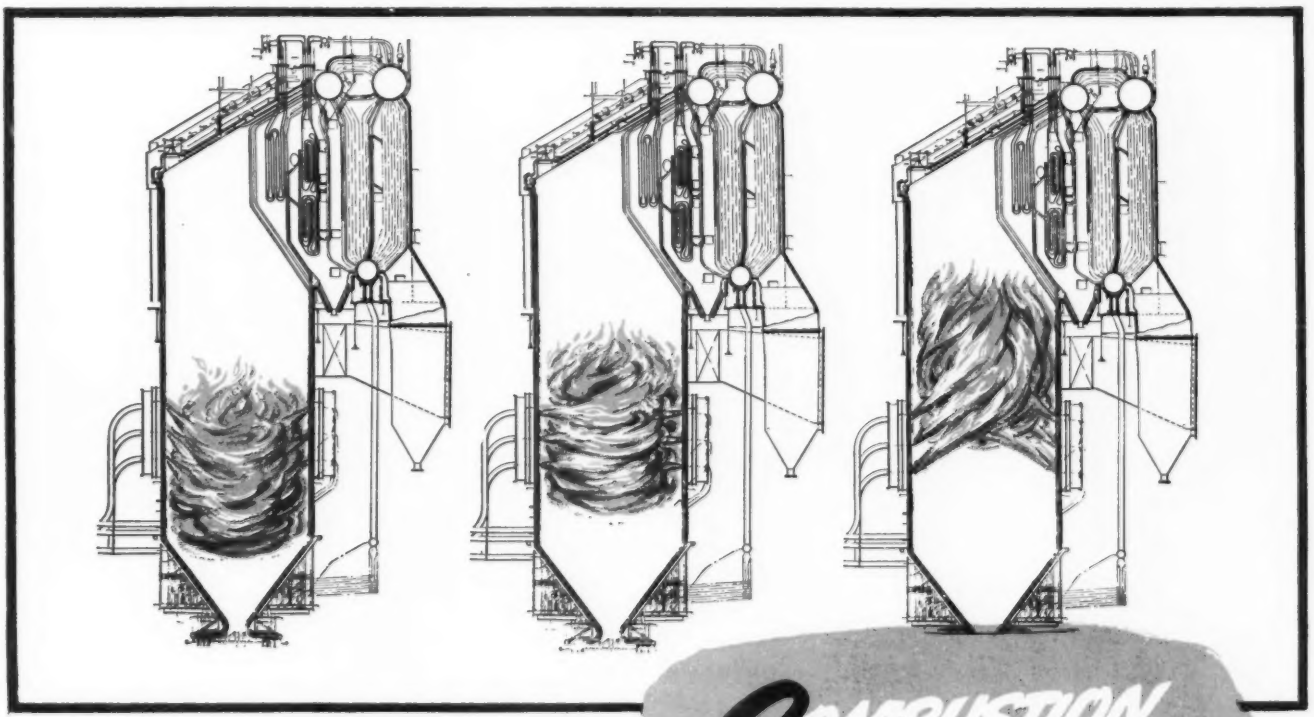
(1) primary, wide range control of superheat temperature

(2) substantial control over slagging conditions

These advantages are obtainable regardless of coal quality or load variation.

The illustrations on this page show how the operator can raise or lower the flame body over a considerable distance to make selective use of more or less furnace heat absorption surface and thereby effect wide range control over the gas temperatures leaving the furnace. Test results in one installation have shown that with the burner nozzles tilted from −24 to +24 degrees, the variation obtainable in gas temperatures at the top of the furnace ranges from 215 F at half load to 165 F at full load.

Since Vertically Adjustable Burners enable the operator to control furnace heat absorption just as though he were able to increase or decrease the size of the furnace at will, they provide, in effect, an "adjustable furnace." A-924

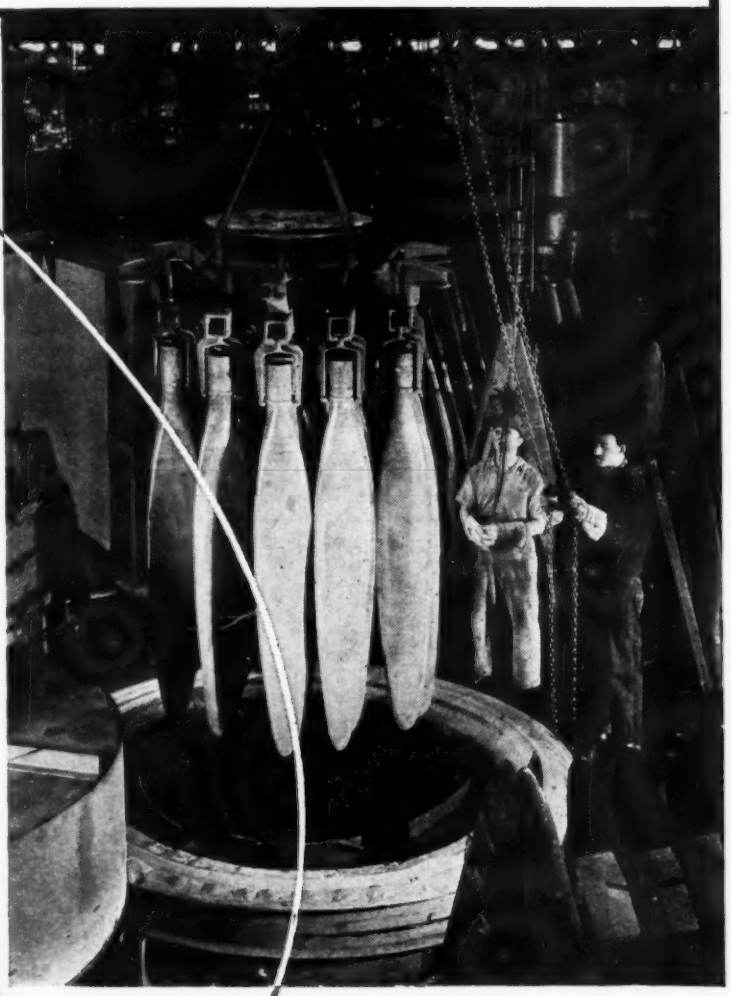


COMBUSTION ENGINEERING

200 *Madison Avenue, New York* 16, C-E *New York*

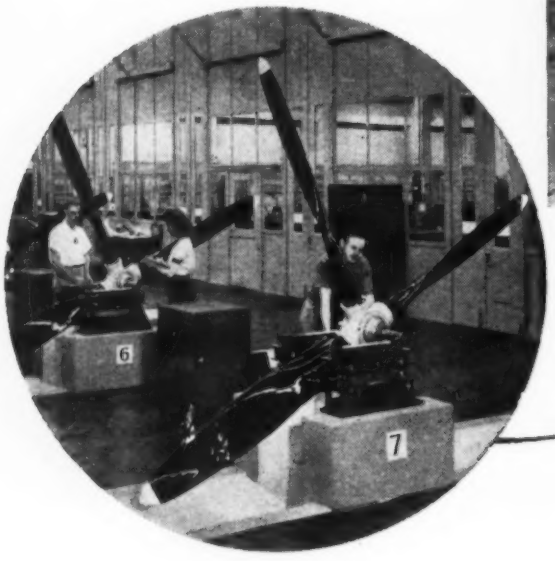
NICKEL STEELS *combine . . .*

EXCEPTIONAL MECHANICAL *and* FABRICATING PROPERTIES



SAE 4330 Nickel chromium molybdenum alloy steel was adopted for Curtiss propeller blades because of its high strength, toughness and good workability, coupled with a wide safe heat-treating range.

High velocity cooling is not necessary to properly harden SAE 4330 for this application. There is no warping to correct by cold-straightening operations nor danger from subsequent stresses that might cause failure in service, because the slow transformation rate of this steel permits hardening to the required degree by die-quenching; thus consequent savings in time and labor, and a uniform final product are provided.



Curtiss Propeller Division of Curtiss-Wright Corporation, one of the largest producers of constant speed propellers, fabricates blades by welding two plates of SAE 4330 into a hollow unit that permits weight saving over solid blades of light metals.

Inquiries on the use of Nickel alloy steels or other alloys containing Nickel in your products or equipment, are invited.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N. Y.

Wide Acceptance!

Though introduced only recently, thousands of Yarway Remote Liquid Level Indicators already have been bought . . . and the list of satisfied users reads like a Who's Who of Industrial Plants, Utilities and Institutions.

There *must* be a reason. There *is!*

The Yarway Remote Liquid Level Indicator brings overhead gage readings right down to eye level, on the instrument panel or other convenient place. No more squinting, straining and guessing. Here is *positive* water level indication . . . instant and accurate because it's operated by the boiler water itself.

Though used primarily for boiler water level indication, the Yarway indicator has proved equally successful in indicating superheater pressure differential, feedwater-heater levels and other liquid levels.

Write for Bulletin WG-1820, or see this indicator and hear its operation explained by Lowell Thomas in the new Yarway color motion picture, "There Is An Engineering Reason", now available for group showings. Write for details.

YARNALL-WARING COMPANY
100 Mermaid Ave., Philadelphia 18, Pa.

YARWAY REMOTE LIQUID LEVEL INDICATOR

Waterloo, Ia. *Repeats*

Two 125,000 Pound Installations

1941 ····· ·1945

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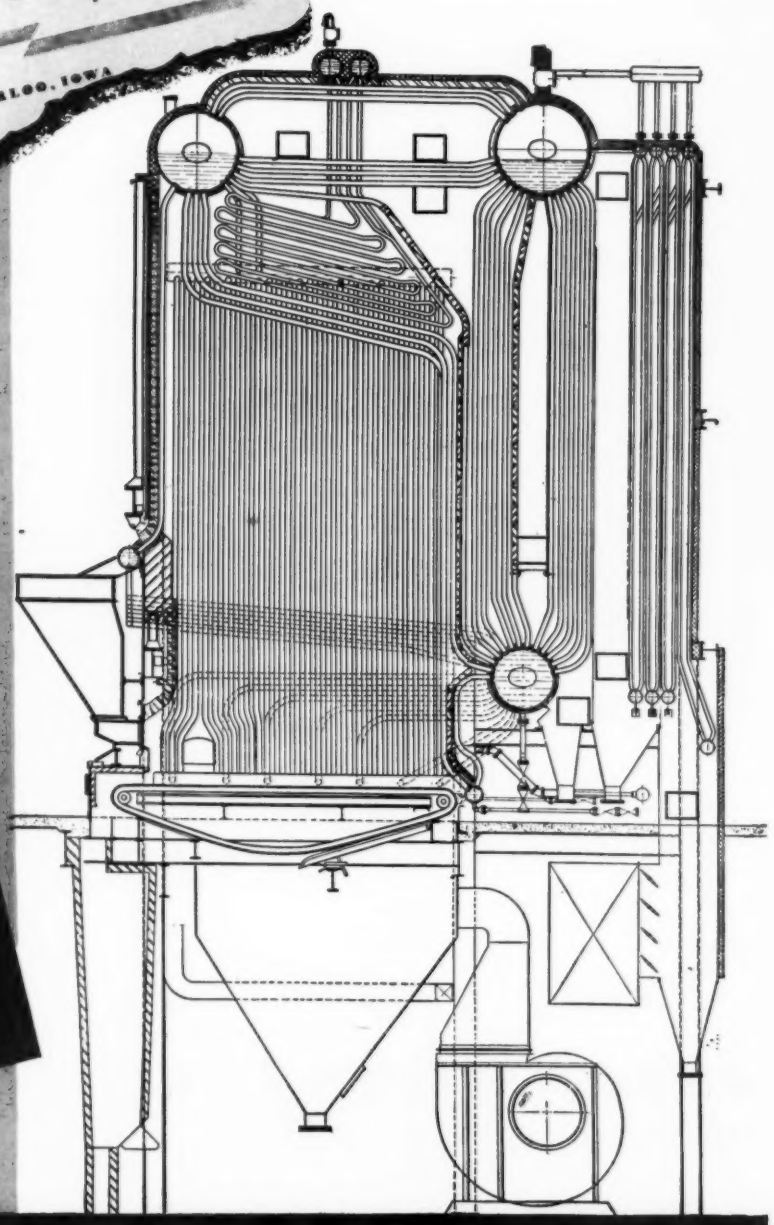
GAS DIVISION

DIVISION OFFICE WATERLOO, IOWA

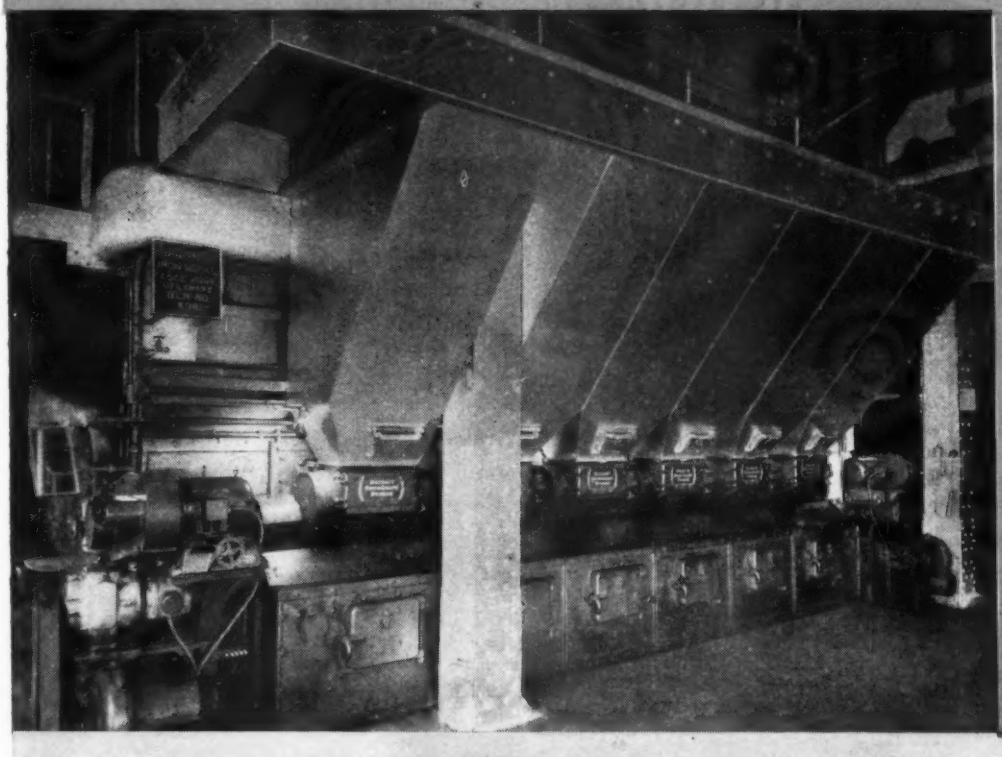


WRITE FOR BULLETIN ON THE

DETROIT ROTOGRATE STOKERS

DETROIT STOKER COMPANY

DETROIT ROTOGRATE STOKERS



IOWA PUBLIC SERVICE COMPANY
Waterloo, Iowa

Investigate the ROTOGRATE

GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN

Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

Convert to LARGER BOILER CAPACITY THIS SIMPLE WAY

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

INSTALL a CASH STANDARD Automatic Combustion Control System and you at once have a sure and permanent answer to greater boiler output at less fuel cost.

CASH STANDARD control instruments meter the fuel supply, whether coal, oil, or gas, so that at every instant the need of that instant is balanced. There is never over-firing to cause waste of fuel or under-firing to cut steam supply and slow up production. Realizing proper combustion is another important result from this modern automatic control. The air supply is continually adjusted as required so that a correct proportion of carbon from the fuel and oxygen from the air is maintained.

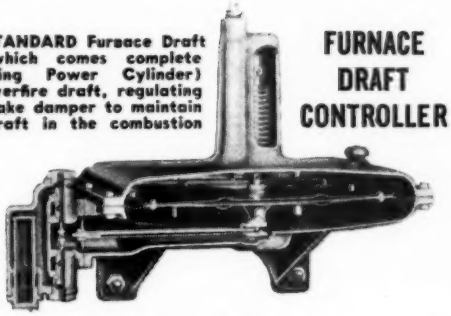
CASH STANDARD Automatic Regulation of the stack damper plays its vital part in seeing that the heat produced is used to generate steam at an astonishingly high degree of efficiency.

Both largest plants and those as small as 75 boiler hp are getting steam plant economy through CASH STANDARD units which make up the systems. These units are available in a number of variations so that all types of boilers and stokers can be successfully equipped.

Bulletin No. 300 gives full details on Automatic Combustion Control for steam plant economy and shows applications of these systems for those who burn coal, oil or gas.

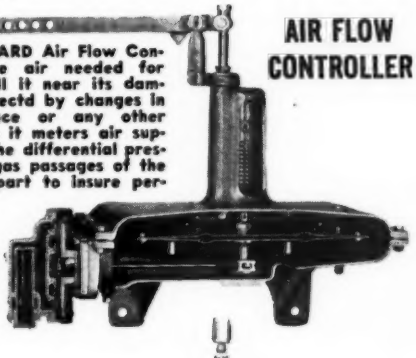
This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

FURNACE DRAFT CONTROLLER



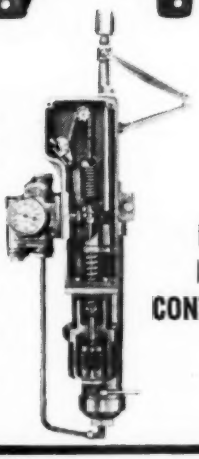
This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affectd by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

AIR FLOW CONTROLLER



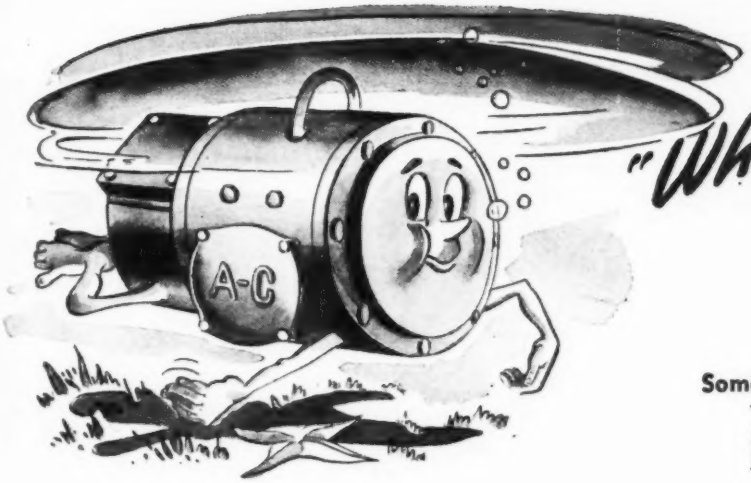
This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

FUEL FEED CONTROLLER



A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

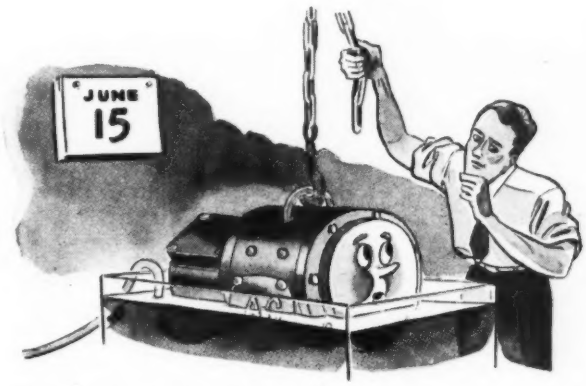


"What! Build a Motor to Run Underwater for 90 Days?"

Some said "Impossible!" But the Navy insisted, "We want a motor that likes water so well it'll run in 25 feet of it for 90 days. What's more—it's got to be lighter, more compact than standard motors."

No diving suits allowed! Biggest problem was water-proof, pressure-proof casings. Cast-iron wouldn't do — too porous. So we turned to fabricated steel — tough, durable — and lightweight too!

Then we found that fabricated parts could be successfully welded together to assure water-tightness. For proper magnetic characteristics, we decided to use field yokes of one-inch rolled steel.



Things look better! We reinforced end-housings, double-checked insulation, made sure exposed parts were leak-proof. Nothing left to do but put our baby in the test-tank, check it regularly, and hold our breath.

90 days later—we took a good look. Motor still running and not a drop of water inside! That called for a short cheer and wide smiles all around. Mass production of these motors followed.

There's a Moral: Every time Allis-Chalmers engineering solves *special* motor problems, we discover new ways to build better standard motors for you. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

A 1927

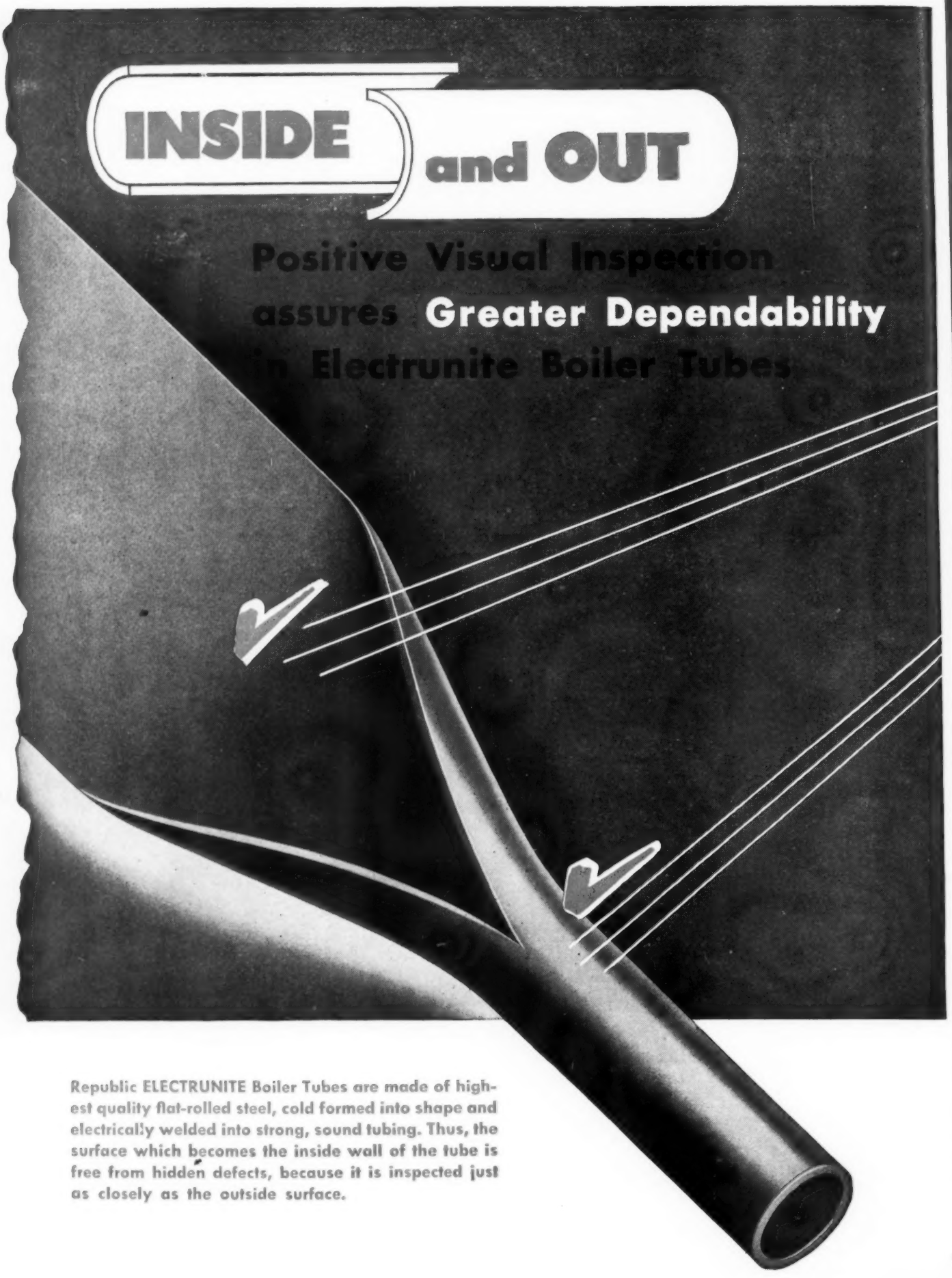
Wait 'til you see the NEW

ALLIS-CHALMERS MOTORS!

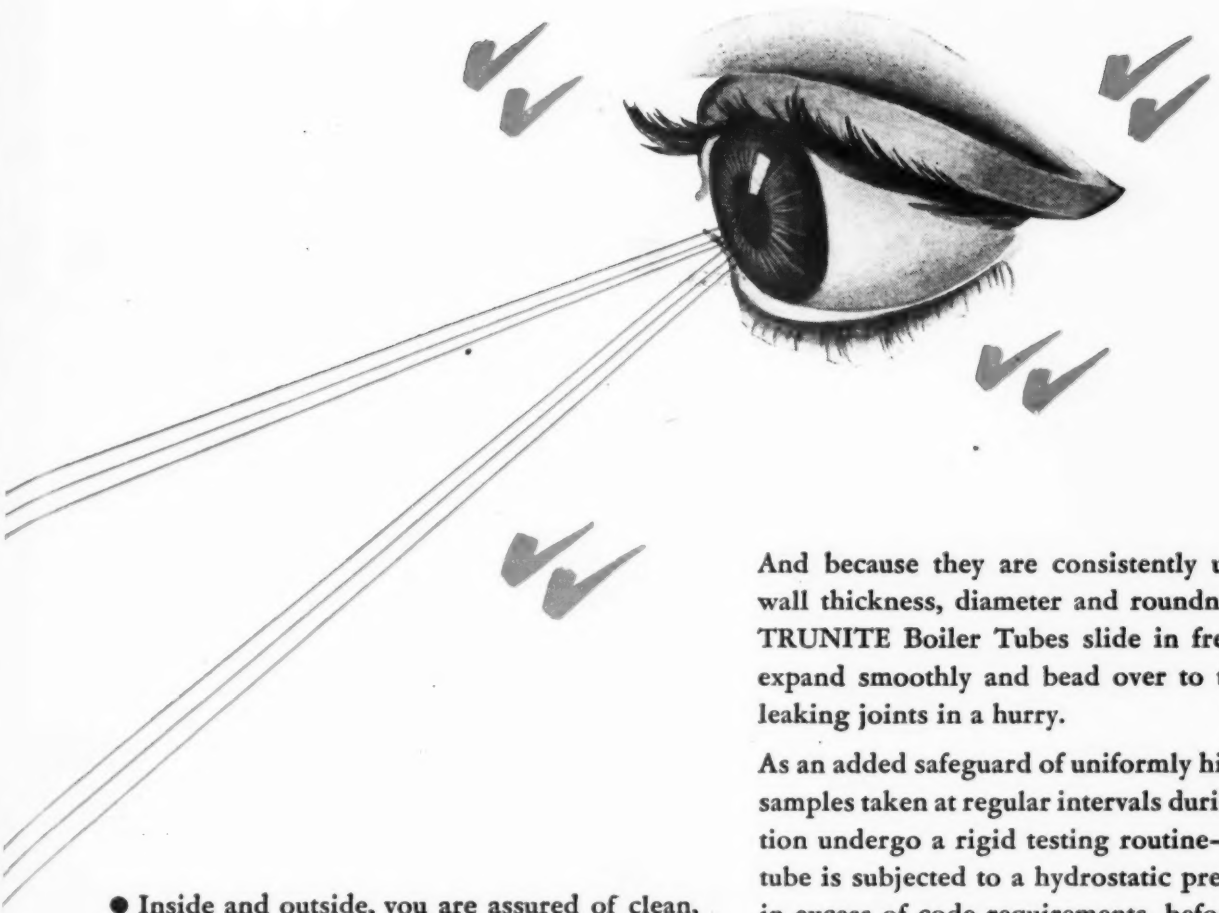
HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co.*

INSIDE and OUT

Positive Visual Inspection assures Greater Dependability in Electrunite Boiler Tubes



Republic ELECTRUNITE Boiler Tubes are made of highest quality flat-rolled steel, cold formed into shape and electrically welded into strong, sound tubing. Thus, the surface which becomes the inside wall of the tube is free from hidden defects, because it is inspected just as closely as the outside surface.



● Inside and outside, you are assured of clean, scale-free surfaces throughout every length of Republic ELECTRUNITE Boiler Tubes.

Why? Because ELECTRUNITE Boiler Tubes are cold formed from flat-rolled steel, both sides of which are open to close visual inspection.

But that's not all! There are other reasons why it pays to use Republic ELECTRUNITE Boiler Tubes.

These *modern* boiler tubes speed up retubing. They are free from hard spots—are uniformly high in ductility—because they are full normalized throughout their entire length.

And because they are consistently uniform in wall thickness, diameter and roundness, ELECTRUNITE Boiler Tubes slide in freely, roller expand smoothly and bead over to tight, non-leaking joints in a hurry.

As an added safeguard of uniformly high quality, samples taken at regular intervals during production undergo a rigid testing routine—and every tube is subjected to a hydrostatic pressure, well in excess of code requirements, before it leaves the factory.

ELECTRUNITE dependability is proved by the fact that more than 150,000,000 feet have been installed in all types of steam generating and heat transfer equipment throughout industry.

For more information about ELECTRUNITE Boiler Tubes and the Electric Resistance Weld Process by which they are made, write for your copy of our new brochure.

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, N. Y.

Republic
ELECTRUNITE
Reg. U. S. Pat. Off.
BOILER, CONDENSER AND HEAT EXCHANGER TUBES

THE ALCO FUEL

for high efficiency and economy

An Extended-Surface Heat Exchanger

Reconversion to peace is under way, and this new ALCO standardized product is a head start to conversion for industrial oil-burner installations.

The heavier-grade and less-expensive oils require preheating for proper atomization and efficient combustion.

Now offered for IMMEDIATE SHIPMENT FROM STOCK, this Alco Fuel Oil Heater offers these important features:

1. HIGH HEAT TRANSFER DUE TO:

Superior baffle design and arrangement.

2. SIMPLICITY OF DESIGN:

A single U tube expanded into removable cover plate.

4. STANDARD SIZES AND LENGTHS:

Six sizes of standard units provided. High-efficiency heat exchangers of any capacity can be built up from these standard ALCO "X-Fin" units.

3. EASY TO CLEAN:

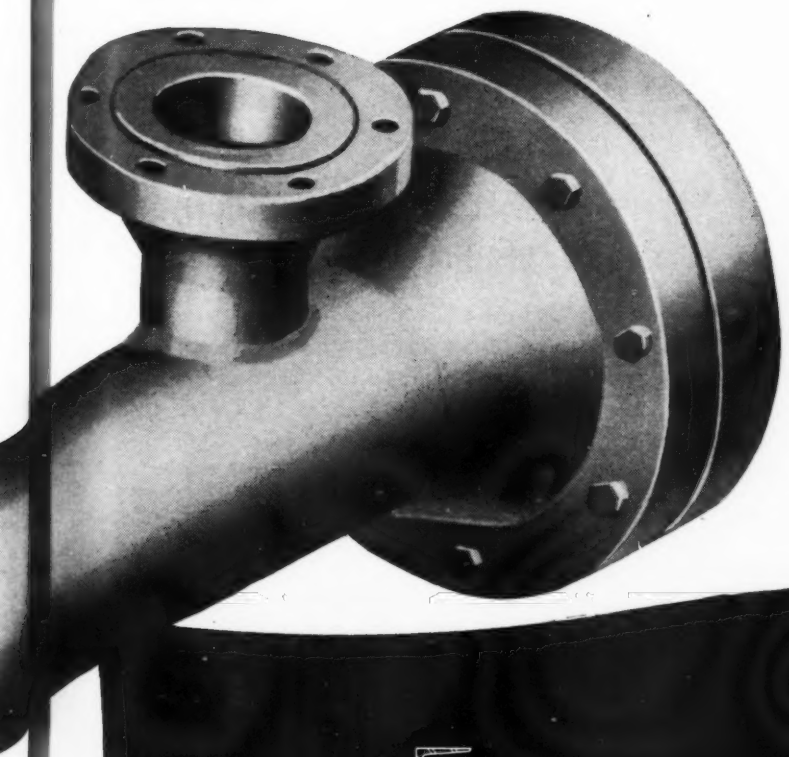
Baffle assembly easily separable from heat-transfer element.

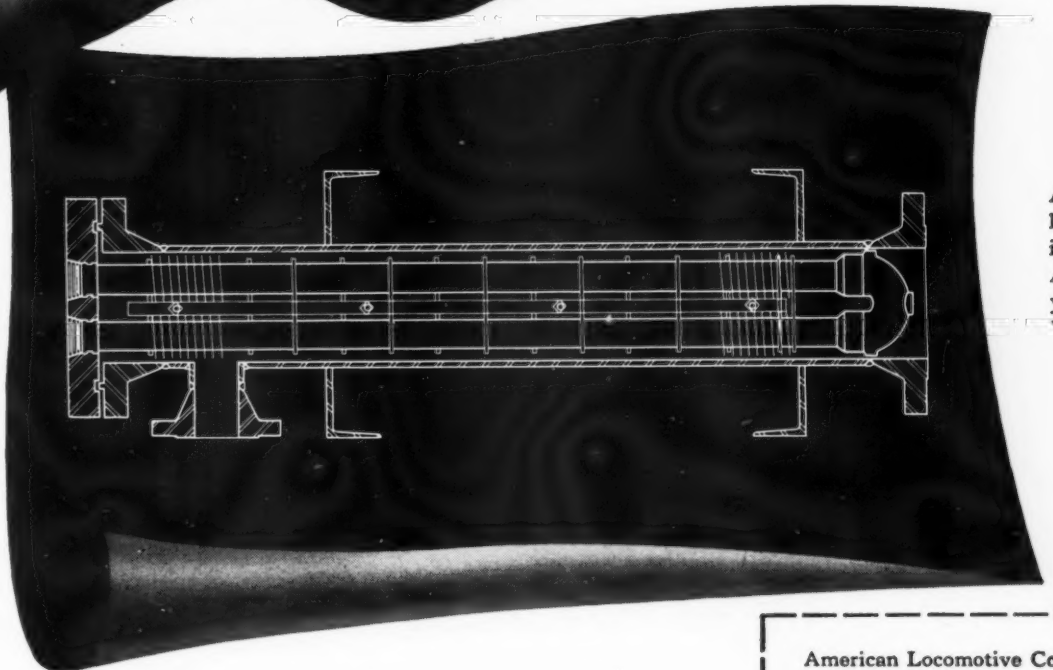
HUNDREDS USED DURING THE WAR, in a wide range of applications besides fuel-oil heating. Here are a few of many suitable applications:

1. Pre-heaters for oil refineries, natural-gasoline plants, chemical plants. 2. Residuum exchangers. 3. Solvent plants. 4. Gas and air heaters. 5. Heaters for caustics, acids, alcohols and other chemicals. 6. Kerosene and gasoline heaters; propane vaporizers and superheaters. 7. Lube-oil coolers. 8. Quench-oil coolers. 9. Duo-Sol coolers. 10. Coolers for alkylation plants. 11. Gasoline and kerosene coolers. 12. Coolers for absorption processes. 13. Gas and air coolers. 14. Compressed-air aftercoolers.

OIL HEATER

in space...weight...cost...and maintenance





OTHER ALCO PRODUCTS:

Oil-Tank Suction Heaters · Feed-Water Heaters

Evaporators · Reboilers

Air-Cooled Heat Exchangers · Lube-Oil Coolers

Jacket Water Coolers · Vapor Heat Exchangers

Vapor Condensers · Waste-Heat Boilers

Prefabricated Piping · Electric-Welded Steel Pipe

Pressure Vessels · Pipe-Line Filters

Weldments

Write for New Bulletin

A copy of the new ALCO Bulletin, No. 1036, describing and illustrating this new line of ALCO products will be sent you promptly, on request. Write for it today.

American Locomotive

ALCO PRODUCTS DIVISION

30 Church Street, New York 8, N. Y. • Dunkirk, N. Y.

American Locomotive Company
Alco Products Division *(7)*
30 Church Street, New York 8, N. Y.

Please send me your new bulletin #1036, about the Alco Fuel Oil Heater.

Name.....

Title.....

Company.....

Street.....

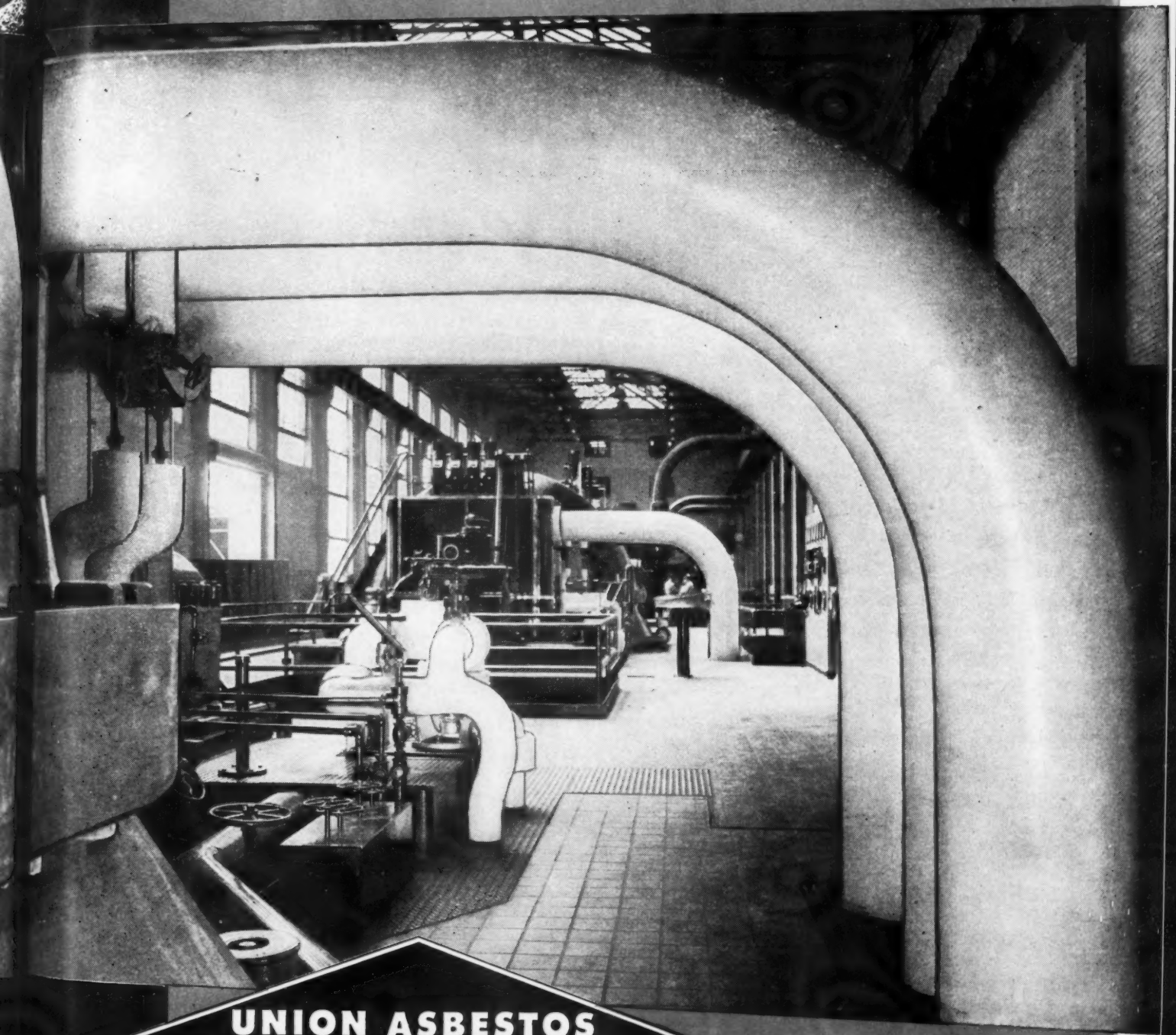
City and State.....

UNIBESTOS, THE SECTIONAL INSULATION, KEEPS B.T.U.'s IN THEIR PROPER PLACE . . .

Easy-to-apply Unibestos (it's *the* half-section insulation—just lay one section on the pipe, place the other section under it and—whoosh!—a steel band draws it together firmly, permanently and quickly!) takes the toughest applications in its stride . . . mitres to fit bends and elbows . . . covers flanges and fittings neatly in two simple operations. Unibestos' fibrous nature (it's made of Amosite asbestos) makes for a more perfect seal.

For a step-by-step picturization of the application of Unibestos to steam lines, tanks, nested lines, etc. write for your copy of the magazine "Efficiency"—Bulletin No. 48-974.

LOSS" WON'T STALK THIS PLANT . . .



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MEANS PROGRESS IN INSULATION
AND RUBBER CO.

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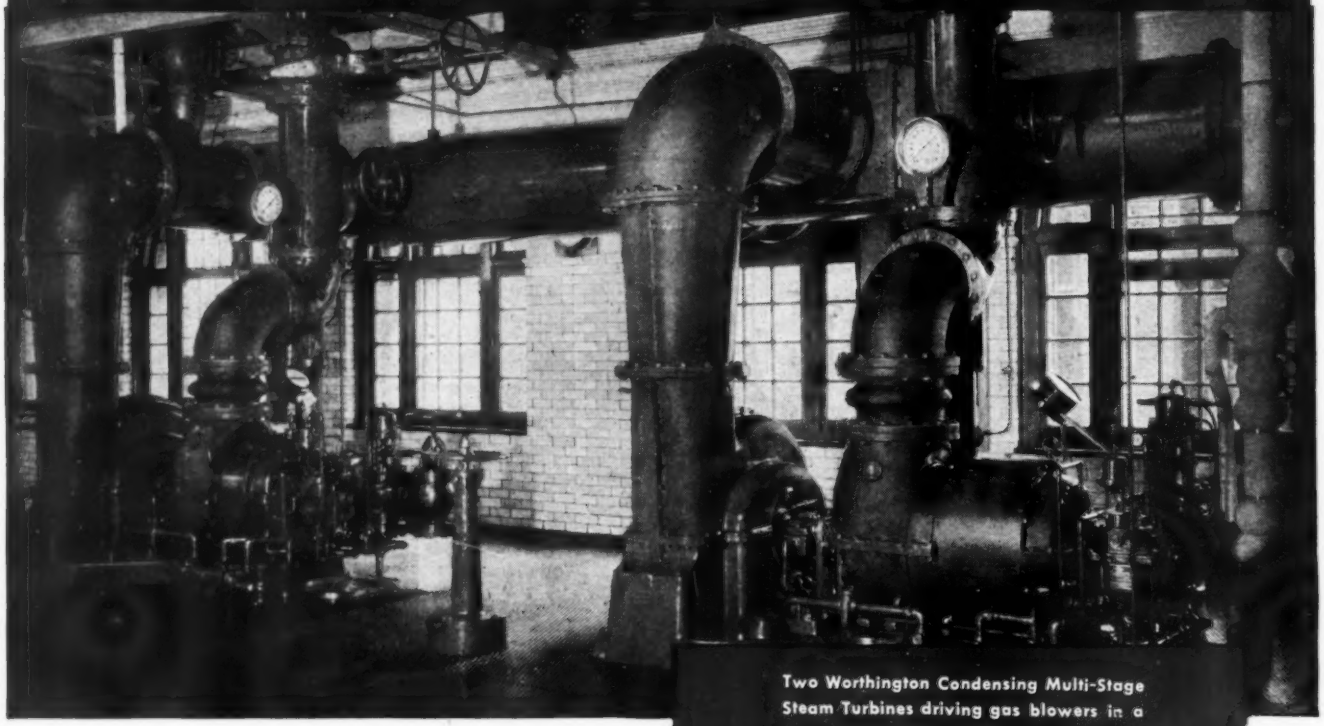
OFFICES: Cicero, Ill. • Chicago, Ill. • New York, N. Y. • San Francisco, Calif.

MORE POWER FROM YOUR STEAM

. . . with Worthington Multi-Stage Turbines



Two Worthington Condensing Multi-Stage Steam Turbines driving gas blowers in a large utility.

You will want to investigate Worthington Multi-Stage Steam Turbines for either condensing or non-condensing service. Worthington's familiarity with all phases of steam power and specialized knowledge of Steam Turbine engineering account for *low maintenance* and *smooth, dependable economic operation.*

Low steam consumption is inherent in the design of these turbines, built in sizes from 100 HP to 10,000 HP for operation on high or low pressure steam and for speeds up to 9000 RPM. For full descriptive literature, write *Worthington Pump and Machinery Corporation, Harrison, N. J.*

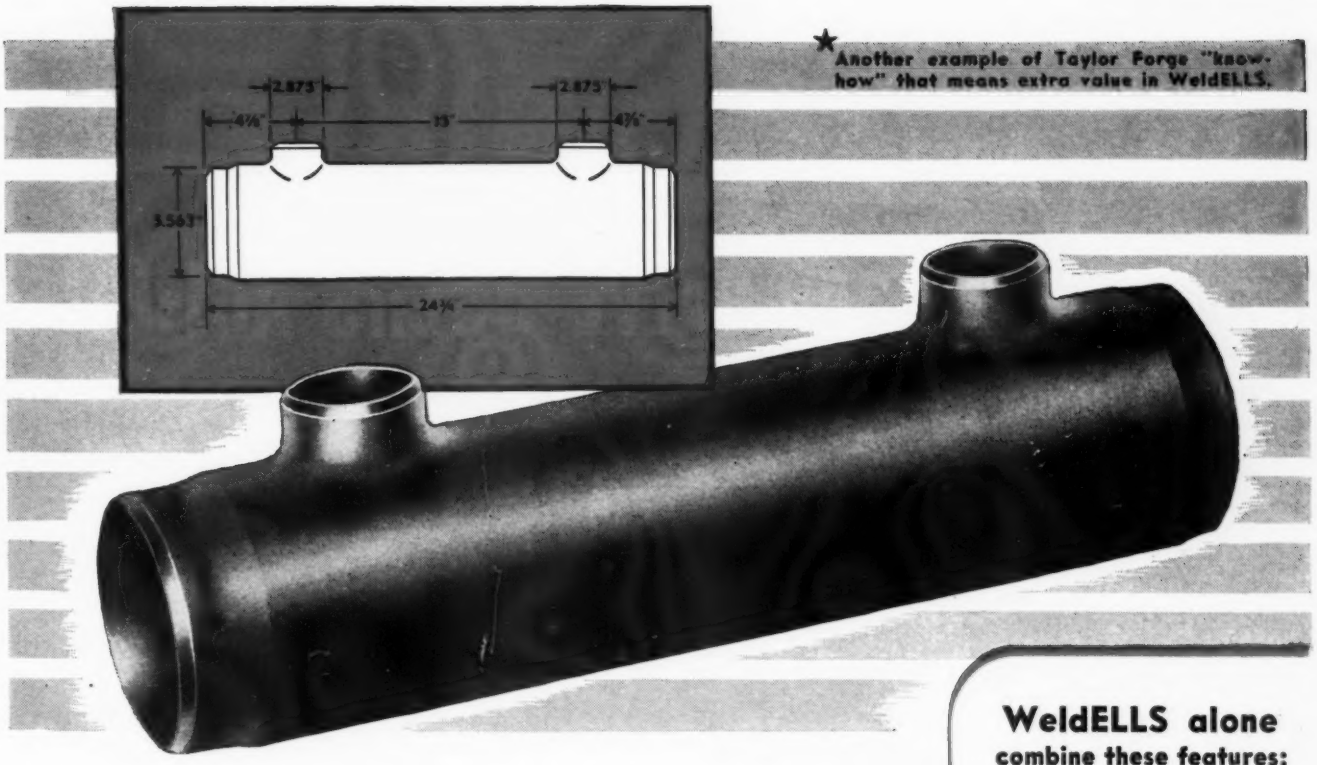
WHO USES THEM?

Worthington Multi-Stage Steam Turbines—condensing and non-condensing types — are now driving blowers, generators, pumps, line shafts, refrigeration compressors, air-conditioning units, paper machines, cane shredders, etc. Data that proves *there's more worth in Worthington* is available on request.

WORTHINGTON

TS-1

A GREAT TEAM IN STEAM



★ Another example of Taylor Forge "know-how" that means extra value in WeldELLS.

TEE FOR TWO.....

Taylor Forge arrangement—

★ *Of course two tees with a nipple welded between them could be made to provide an assembly with the same dimensions as this special "tandem outlet tee." However, a rigid set of conditions demanded this seamless one-piece fitting. From there on it was the old familiar story: "This is a tough one—one for Taylor Forge."*

YES, you've heard the story before: A tough one is one for Taylor Forge! It's really no wonder so many of the people who come to Taylor Forge for the unusual, and often very difficult jobs, are equally careful to see that their needs for standard welding fittings are always supplied by Taylor Forge.

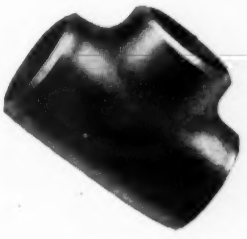
They *should* be equally careful, because the very same factors that have built the Taylor reputation for licking the tough ones, provide many extra values that are found only in WeldELLS and other Taylor Forge fittings for pipe welding.

In the sense of knowledge and experience, WeldELLS, too, are "special." Special steps are necessary to achieve uniform strength through selective distribution of extra metal where stresses are greatest. Special truing operations give WeldELLS their remarkable dimensional accuracy. Special processes account for the tangents and many other features of WeldELLS.

In fact, you will find Taylor Forge know-how reflected in every one of the features listed opposite. Check the list and we believe you will agree that

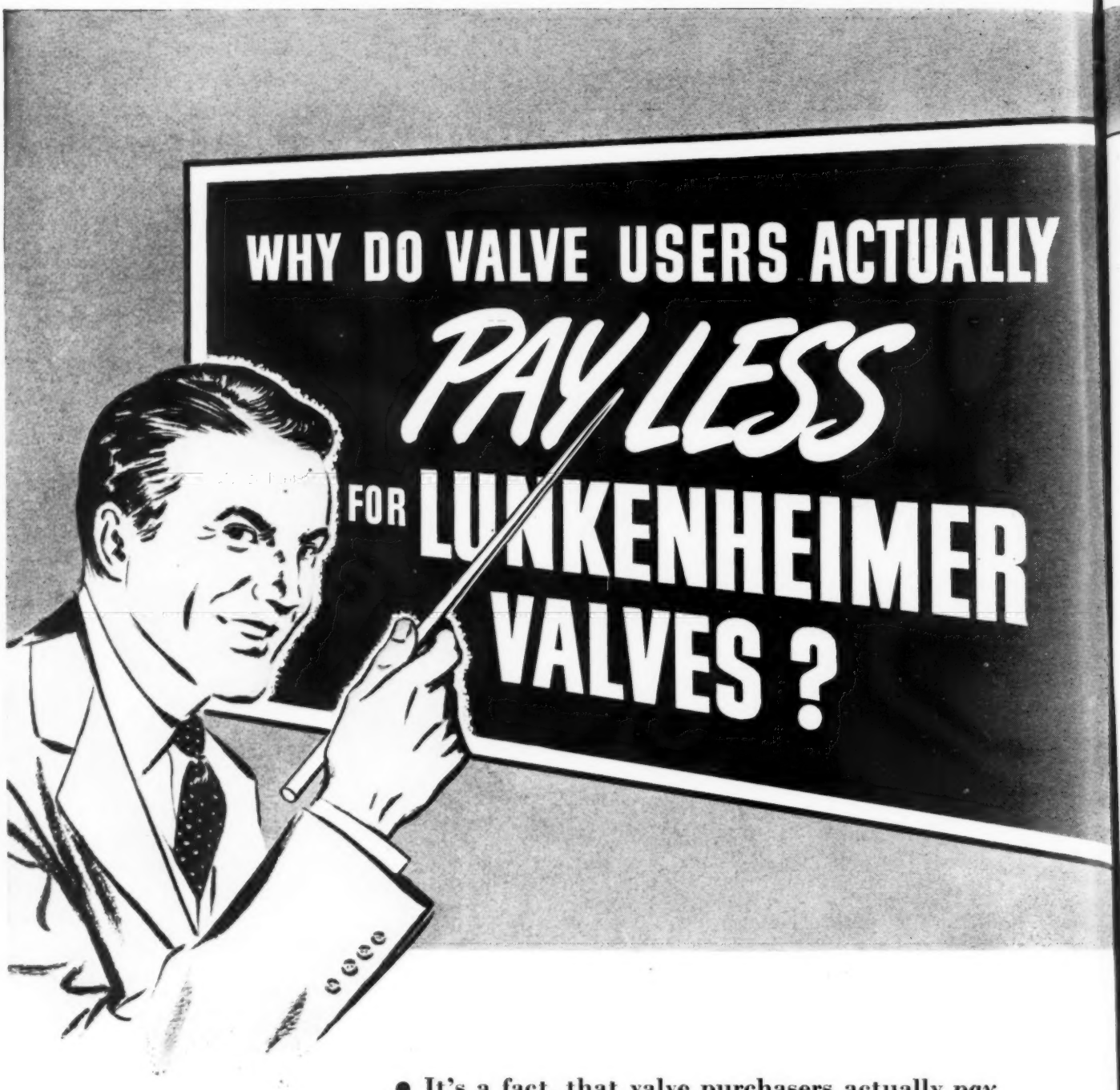
WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.



WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.



● It's a fact, that valve purchasers actually *pay less* for Lunkenheimer Valves—because these quality-built Valves give definitely *better service, longer service, more trouble-free and economical service.*

Maintenance men everywhere know they can confidently rely on the superior performance of any product bearing the Lunkenheimer name—backed as it is by a tradition of highest quality and skilled craftsmanship.

THE LUNKENHEIMER CO., Cincinnati 14, Ohio, U. S. A. Offices: New York 13, Chicago 6, Boston 10, Philadelphia 7. Export department: 318-322 Hudson St., New York 13, N. Y.

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S. P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

Fig. 2125
Bronze Gate

Fig. 123
"N-M-D"
Globe

Fig. 1430
Iron Body
Gate

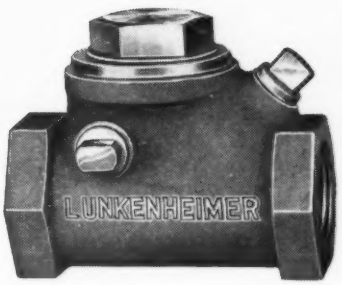
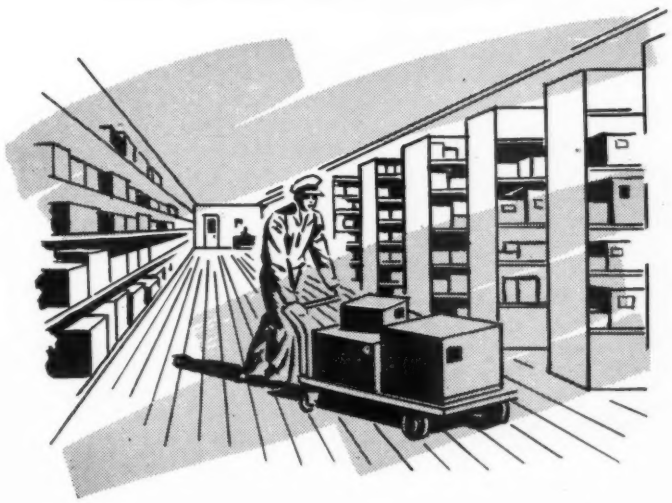


Fig. 554
Bronze Swing Check



YOUR LUNKENHEIMER DISTRIBUTOR

plays a very important part in rendering the *better valve* service for which Lunkenheimer is noted. He is fully equipped and ready at all times to help you solve problems of valve maintenance or operation. Lunkenheimer Distributors are located in all industrial centers. There's one near you . . . call him for your requirements.

LUNKENHEIMER VALVES

What 0.04% Phosphorus Does To Your Dezincification Problem

Plain Admiralty Metal has almost all the properties for successful condenser and heat exchanger tube service that are needed to meet many power plant and oil refinery applications . . . but it has one weakness — fair to poor resistance to dezincification.

Under certain conditions, its brass content is gradually replaced by a spongy, porous copper deposit, locally (plug type) or uniformly over the tube (layer type).

To overcome this problem . . . and still retain the high corrosion resistance of plain Admiralty . . . Scovill *Service in Metals* developed Phosphorized Admiralty*. This is the alloy that Scovill engineers are recommending for many types of power plant and oil refinery service where dezincification of plain Admiralty has been observed or anticipated.

Many Times Greater Life

By inhibiting dezincification, Phosphorized Admiralty offers much longer service life. This improvement is brought about by a very slight change in the alloy composition — the addition of approximately 0.04% phosphorus. There is no appreciable difference in the structure or mechanical properties between regular and Phosphorized Admiralty as shown by the photomicrographs and graph at the right. There is no impairment of the metallurgical, physical and otherwise excellent corrosion-resistant properties.

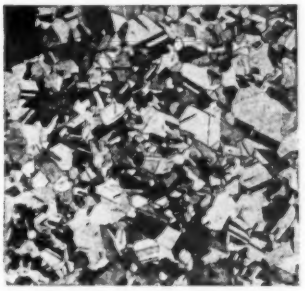
Experience of Scovill customers has shown that in cases where dezincification has been troublesome, a change to Phosphorized Admiralty extends service life.

*"Phosphorized Admiralty Tubes" for condenser and heat exchanger service are covered by patent 2,224,095 and can be legally supplied only by Scovill Manufacturing Company, the owner of this patent.

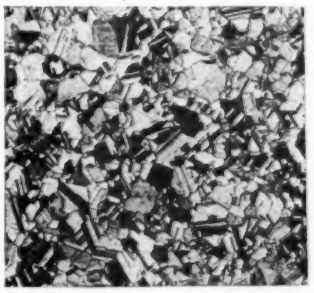
Other Scovill Services

Service in Metals, which includes the development of new alloys to meet changing service conditions and also individual study of specific customers' problems, is one of three Scovill services, well-known throughout Industry. *Service in Men* provides specialized advice on tube problems, installation aids and "follow-up" services. *Service in Manuals* offers valuable literature on condenser and heat exchanger tubes. For a copy of our Condenser Tube Booklet, address Scovill Manufacturing Company, 13 Mill Street, Waterbury 91, Conn.

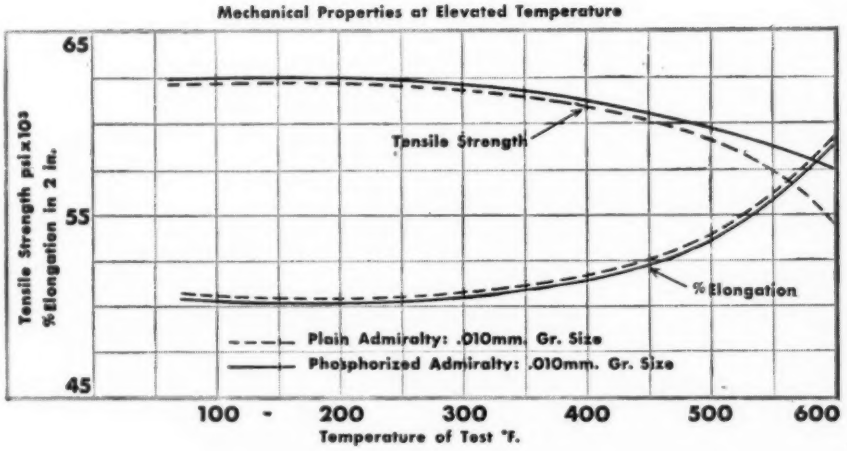
Top: Plain Admiralty.
Bottom: Phosphorized Admiralty.



75 x magnification.
Average grain size .035 min.



Mechanical Properties at Elevated Temperature



Plain Admiralty		Phosphorized Admiralty	
Copper	70.0 — 73.0	Copper	70.0 — 73.0
Tin	0.90 — 1.20	Tin	0.90 — 1.20
Lead	0.075 max.	Lead	0.075 max.
Iron	0.06	Iron	0.06
Phosphorus		Phosphorus	0.10 max.
Zinc	remainder	Zinc	remainder

Scovill
MANUFACTURING COMPANY
WATERBURY 91, CONN.

SCOVILL CONDENSER TUBES

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can help you put a new low ceiling on your Diesel Maintenance costs!

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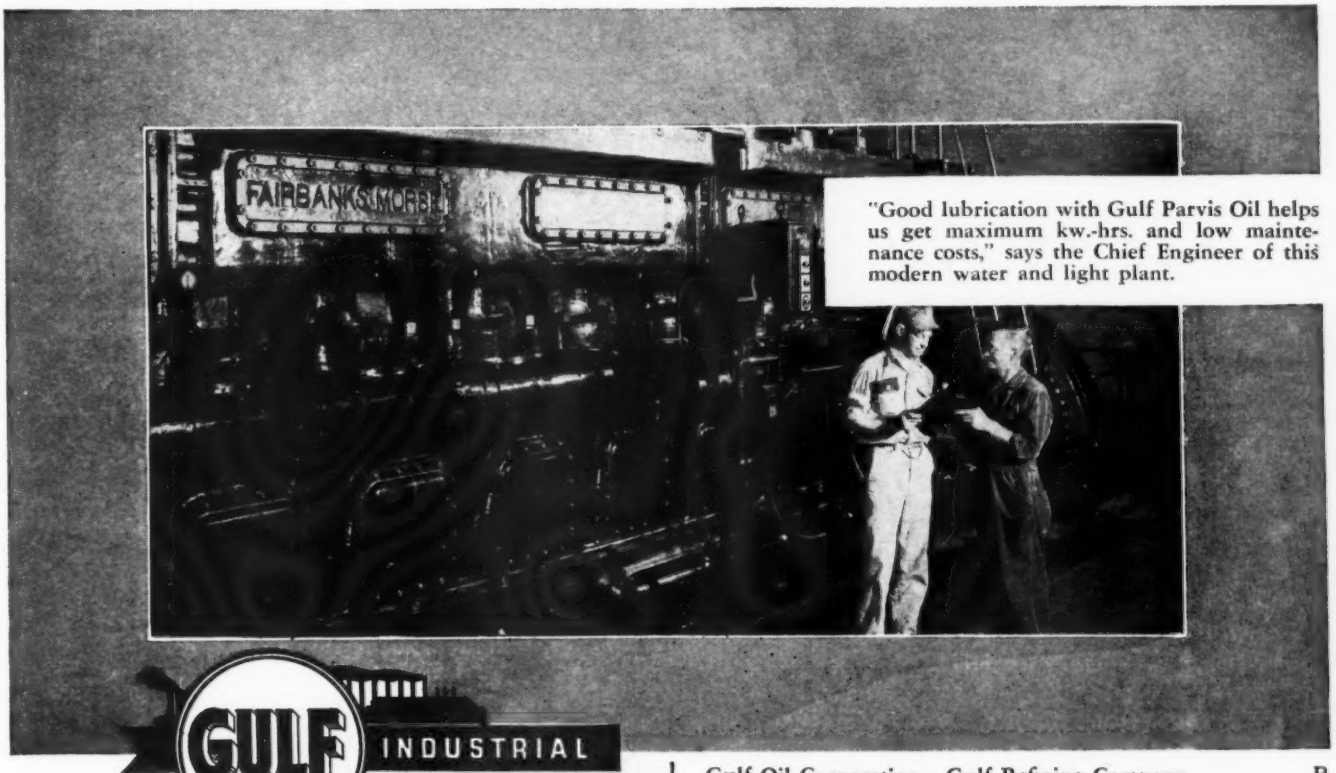

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Company.....

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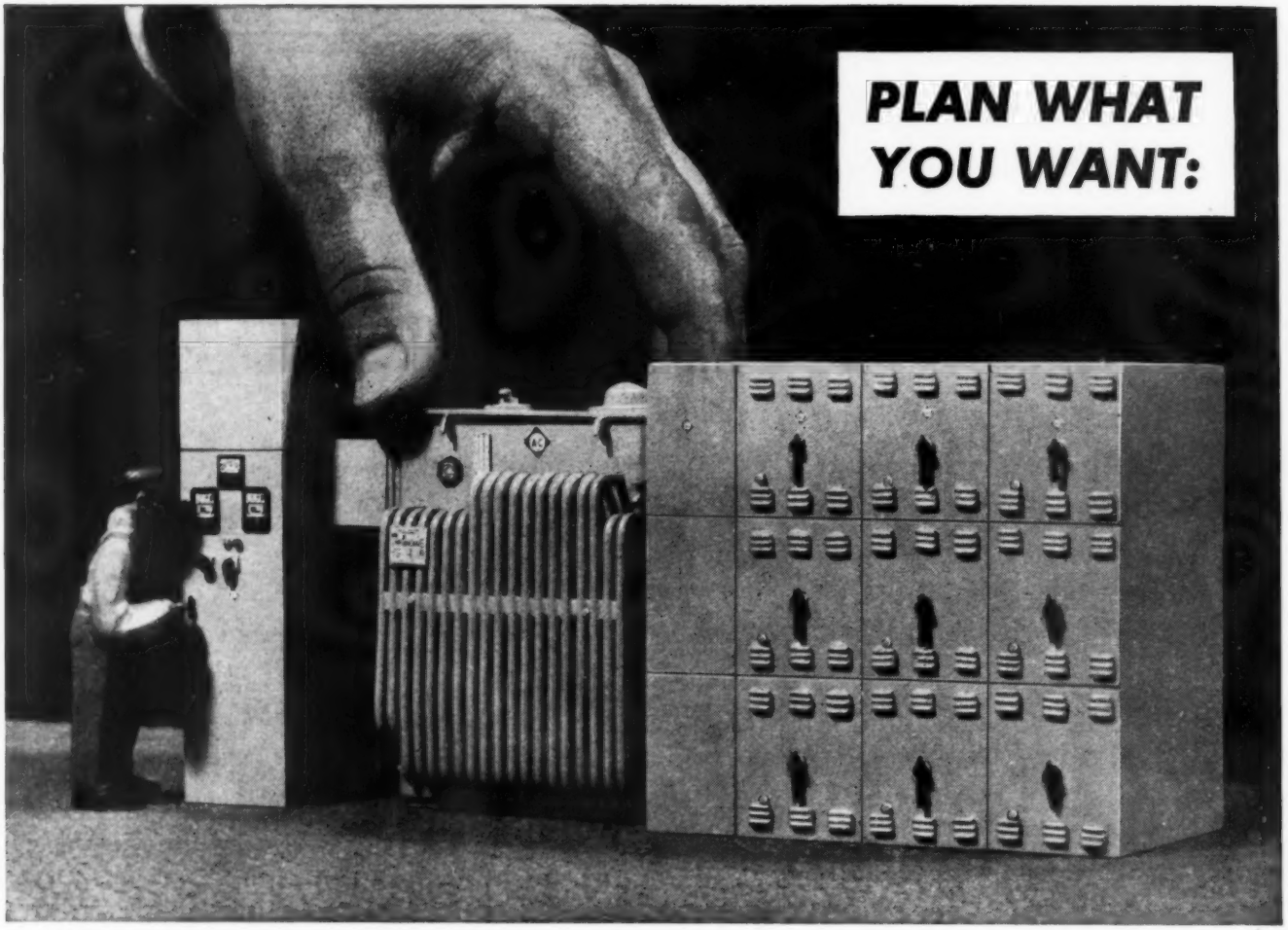

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GUESSWORK GOES when you call on Allis-Chalmers' "Unit Sub Builder" Set to help you select the right prefabricated load center unit substation for your plant.

You protect yourself against costly power distribution mistakes when you *pre-test* your ideas with Allis-Chalmers models . . . because you *see* just what you're getting in terms of dimensions, characteristics, appearance.

In addition, visual planning is quick, easy, accurate. You build the answers to your unit sub problems *right on the top of your desk*. At a glance you see equipment that's available, the various ways it can go together, how the *right* unit substation will look when installed in your own plant.

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Unit Sub Builder Set

An even clearer picture will result if the models of Allis-Chalmers unit substation equipment are built up on a floor plan of your plant drawn to the same scale.

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In the comparatively short period Allis-Chalmers' "Unit Sub Builder" Set has been available for assisting power distribution planners, engineers of many leading U. S. firms have taken advantage of its time-saving, trouble-saving benefits. They like the idea of working out solutions . . . without bogging down in complicated charts and catalogues.

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An A-C field engineer will bring the models, together with a handy "Unit Sub Slide Rule" for calculating breaker capacities — and a "Check List" to give you the added planning safety of a *double check*. ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WISCONSIN.

A 1951

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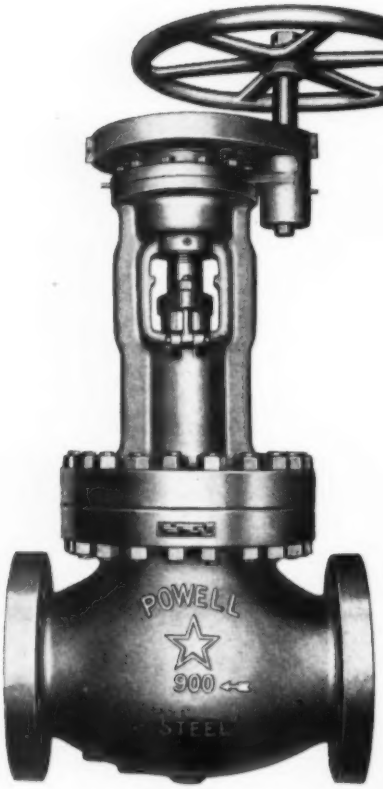
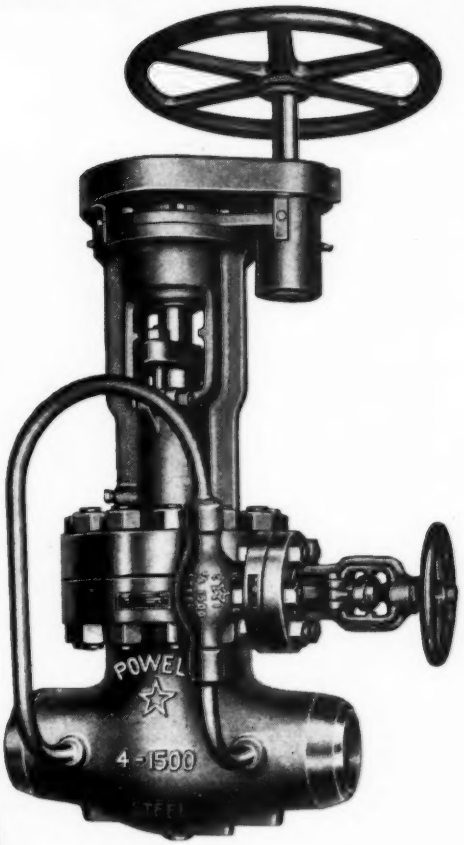
POWELL
for High Pressures and Temperatures



Class 900-pound Flanged End Cast Steel Non-return Globe Valve. Spur gear operated.

Class 900-pound Cast Steel, Gear Operated Gate Valve with welded bonnet, special by-pass, and sediment and inspection cap.



Class 1500-pound Cast Steel Globe Valve with welding ends and welded by-pass. Spur gear operated.

POWELL

VALVES

For 100 years Powell has been making valves to meet every new demand imposed by the amazing developments in all branches of American Industry.

Thus, when a definite trend toward higher pressures and temperatures started to develop in the power field, Powell was ready with a complete line of Cast Steel Valves of all types—Globes, Angles, Gates, Checks and Non-returns—correctly engineered to meet the new conditions.

Various features to facilitate manual operation at the higher pressures were made available. These include anti-friction bearing yokes, available in all pressure classes and regularly furnished in certain sizes; spur and bevel gear and toggle operation for the larger sizes; and where remote control together with quick, positive opening and closing is essential, electric motor operators can be supplied. Catalogs and detailed information on request.

The Wm. Powell Co., Cincinnati 22, Ohio

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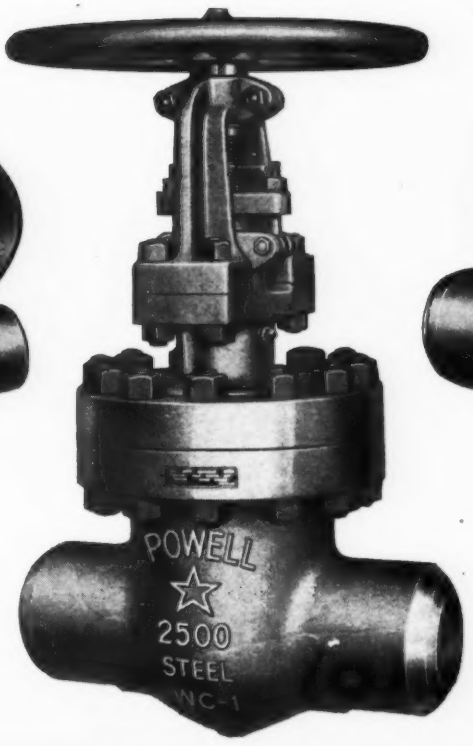
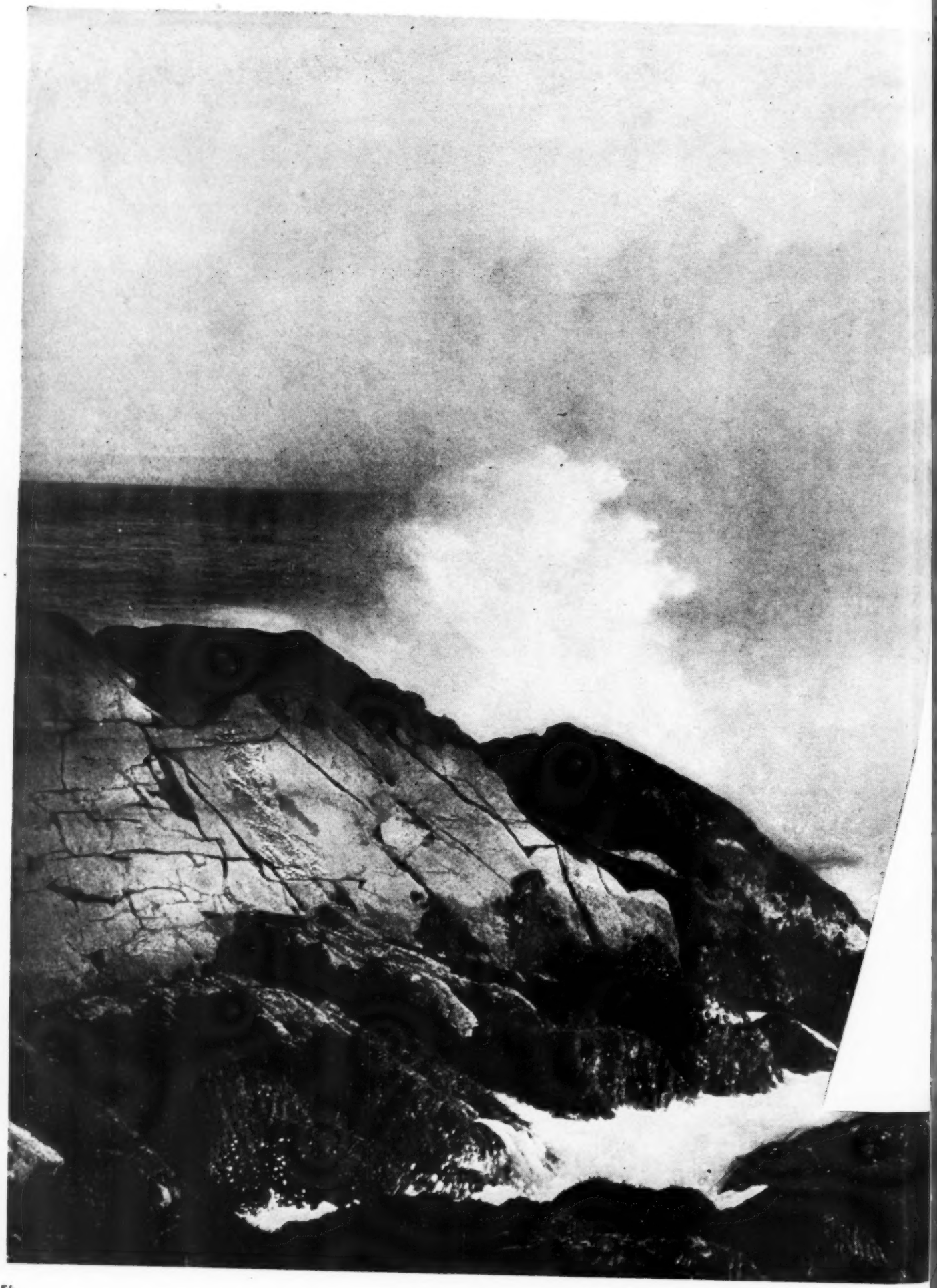
Class 1500-pound Cast Steel, Toggle Operated Non-return Angle Valve with welding ends. Has 16" outlet and two 12" inlets. Because of special streamline designing, the pressure drop through the valve is reduced to a minimum.



Class 2500-pound Cast Steel Welding End O. S. & Y. Gate Valve.

Class 600-pound Cast Steel Swing Check Valve with welding ends and bolted cap. Disc is hung on a 5-degree angle and, when wide open, permits full, unobstructed flow through the valve body.

VALVES



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Write today *for our free booklet giving complete details on the formation and methods for prevention of boiler scale. You will be interested in such specific topics as the mechanics of scale formation — effect of boiler scale — internal chemical treatment — control of chemical treatment — and feeding of internal correctives. Ask for Bulletin 98-A. W. H. & L. D. BETZ, Gillingham & Worth Sts., Philadelphia 24, Penna.*

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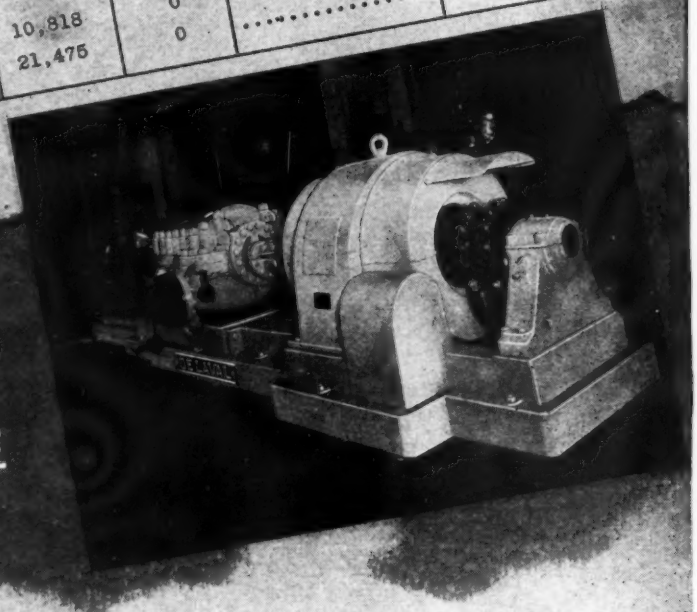
Look at the Record!

SERVICE RECORD—As of September 1, 1944

DE LAVAL PUMPS at _____

No.	Discharge Pressure psig	Suction Temp. °F.	Placed in Service	Total Service Hours	Outages Due to Pump	Cause of Outages	Approx. % Increase in Pump Power
14	1186	260°	12- 2-38	40,383	2	Replace ball locating bearing and shaft sleeves	Negligible
15	1186	260°	10-11-40	28,839	1	Replace shaft sleeves	Negligible
21	1186	350°	8- 4-39	10,818	0	.....	Negligible
16	1186	260°	1- 2-42	21,475	0	.....	5%

Capacity (all units).....1455 g.p.m.



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Not one major trouble after as much as 40,000 hours of service!

The first of these units was installed in February, 1938; the most recent in February, 1942. All have demonstrated the satisfactory performance of De Laval boiler-feed pumps for high-pressure central station service.

Other important installations, operating at pressures up to 1600 psi and handling high temperature feed water, are operating with equal freedom from trouble, due in no small measure to the excellent performance of the De Laval automatic balancing device, the De Laval large clearance labyrinth wearing rings, and the sturdiness of De Laval solid end head construction.

3629

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JANUARY, 1946 VOLUME 90, NUMBER 1

A CROSS-INDEX OF SUBJECTS FOR THE MONTH

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STEAM GENERATION, FUELS, FIRING AND COMBUSTION
TURBINES, ENGINES, AUXILIARIES; HYDRO POWER
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STEAM SERVICES, HEATING
INSTRUMENTS, CONTROLS
PUMPS, COMPRESSORS

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DUAL PROTECTION..

Although necessary only in emergencies—overspeed protection is important for safe turbine operation. On Westinghouse Type C Turbines . . . Dual Protection, a Westinghouse exclusive, provides maximum safety against overspeed.

Westinghouse Dual Protection acts upon the same valve as the governing mechanism—a valve which is in constant daily use. It also closes an independent butterfly valve . . . consequently, Dual Protection is always in position to function when needed.

This built-in plus value is typical of many you'll find in every Westinghouse Type C Turbine.

You get extra reliability, extra safety, extra economy in operation—and the use of steam drives may improve the heat balance of your entire plant.

Type C general-purpose mechanical drive turbines are built in five different sizes, covering a range of 5 to 1500 hp. The long list of proved-in-service installations includes pumps, forced and induced draft fans, pulverizers, compressors, Jordans, pulp beaters, lineshafts, generators—and many others. For complete information call your nearest Westinghouse representative. Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

J-50460

Westinghouse

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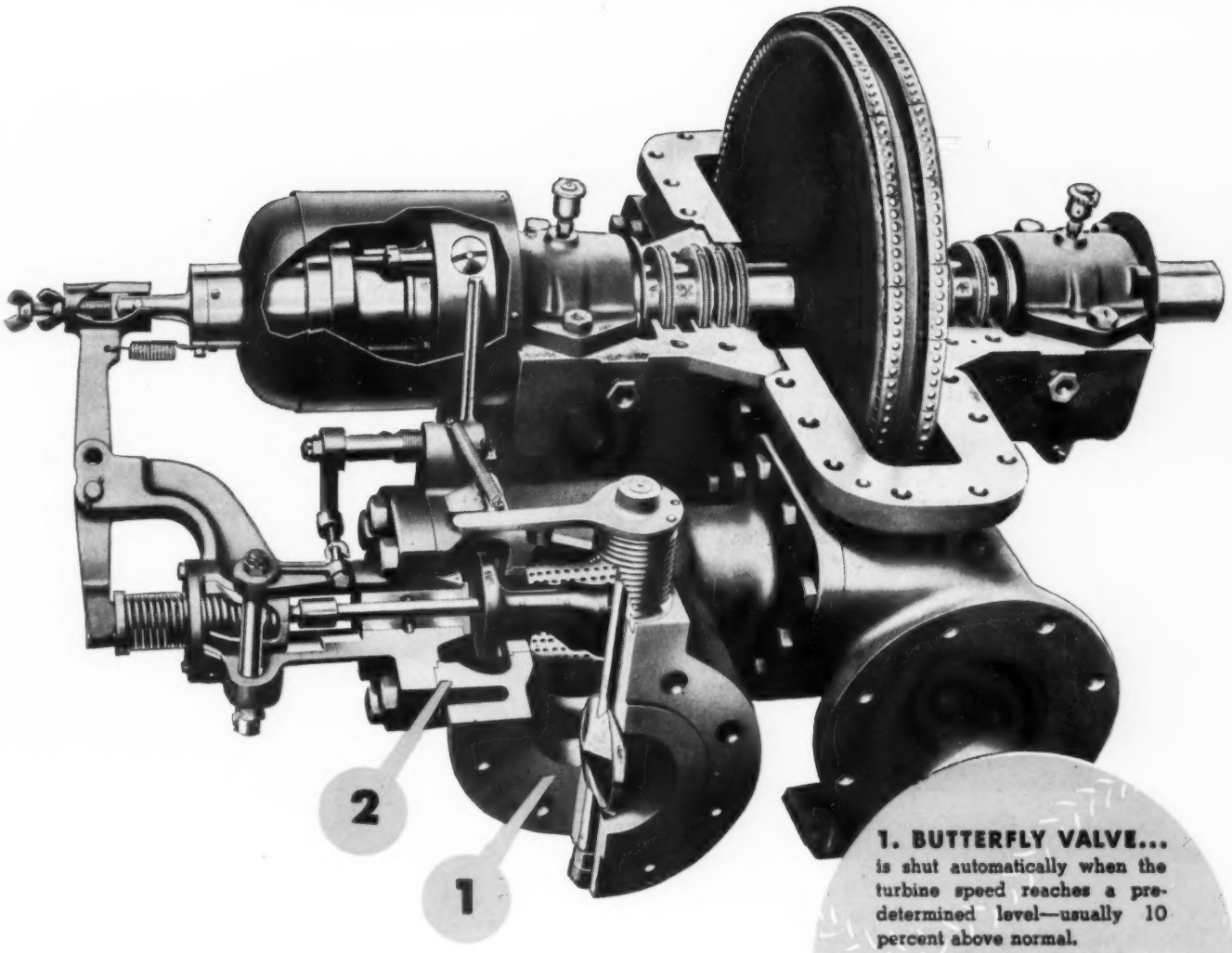


1. BUTTERFLY VALVE... is shut automatically when the turbine speed reaches a predetermined level—usually 10 percent above normal.

2. GOVERNOR VALVE... is tripped simultaneously with the butterfly valve—giving positive assurance that the steam supply will be shut off.

. . STOPS OVERSPEED

ON WESTINGHOUSE

TYPE C TURBINES

By making Dual Protection a *standard feature* of Type C Turbines, Westinghouse has made available to industry a degree of operating safety not previously obtainable.

During normal operation the speed of the Type C Turbine is controlled by the centrifugal weight governor—or by a regulator. If for any reason this control should fail, the overspeed trip device takes charge —simultaneously closing two valves, as shown above.

Steam Headquarters

WESTINGHOUSE

Power plants *can't afford failures* in Water Supply so they used *BYERS WROUGHT IRON*

The old mill with its overshot wheel was no more dependent on a continuous water supply than is the modern power plant. The factor of dependability was given proper weight when the Georgia Power Company recently installed an underground line from its Atkinson Steam Plant near Atlanta, to the city mains 4000 feet away. The 6, 8 and 10-inch pipe used was Byers Wrought Iron. Williams Bros. Corporation of Chamblee, Ga., were the contractors on the job.

Every underground pipe installation should be planned with particular care, for in addition to the corrosion that may come from the fluid within, severe attack should be anticipated from the soil without. Soil types, electrolytic and galvanic action, and bacterial action all play a part in determining the type and severity of attack, and help to make the subject of soil corrosion one of the most complex that the student of this subject encounters.

Fortunately, it isn't necessary to have a complete theoretical knowledge of soil corrosion in order to find a practical cure. Byers Wrought Iron has been successfully used in a wide variety of locations, representing most of the conditions that will be encountered, and its record provides an excellent guide in specifying. For instance, a 50-inch underground water line is still serving in a Pennsylvania community after 60 years of use . . . and only one leak has ever been reported. An engineer reported a 21-year-old wrought iron line still in service in southern marshland, where ordinary materials failed in as little as four years. These are but two examples from many.

The reason for wrought iron's unusual resistance is found in its unusual structure. Tiny fibers of glass-like silicate slag are threaded through the body of high-purity iron. Corrosion is halted and diffused by the fibers, which also help anchor the initial protective film that shields the underlying metal.

You will find some helpful information in our bulletin, "Wrought Iron for Underground Services." We will be glad to send you a copy. And don't forget that wrought iron is available now, in any quantity, for any project you have up.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco, Atlanta.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

BYERS
GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
ELECTRIC FURNACE ALLOY STEELS · OPEN HEARTH ALLOY STEELS
CARBON STEEL TUBULAR PRODUCTS

POWER

PHILIP W SWAIN, EDITOR • JANUARY 1946 • ESTABLISHED IN 1882

POWER FOR YEARS OF PLENTY

THIS IS THE NEW YEAR, first year of peace since 1940. Economists agree we are entering a long period of plenty based on high production. It may be five years, it may be more, but this is surely one of those "tides in the affairs of men."

Right now duty and opportunity knock at the doors of all responsible men of industry, including the power engineers. The engineers' problem is to combine fast action with judgment.

On the one hand are thousands of obsolete and undersized power plants demanding immediate revamping and extension. On the other is the realization that today's power installations will determine power cost and adequacy for a decade. The power blunders and smart moves of 1946 will mar or make future dividends.

Since ten years ahead is too far to see now, here are power-guiding predictions for 1946-1951: (1) a production level (true goods, not inflated dollars) 40 to 60% above 1939, (2) wages and fuel prices stabilized far above 1939 levels, (3) more direct and indirect power per worker, (4) probably an increasing ratio of power load to heat load in industry, (5) increasing public objection to smoke and stack dust.

Power-service loads will be determined first by the new high level of production, second by each high-paid worker's greater use of direct power for his production machines and indirect power for materials handling and similar services. Power-plant capacity must match the new load levels. This applies to steam, electricity, hot and cold water, compressed air, refrigeration and other power services.

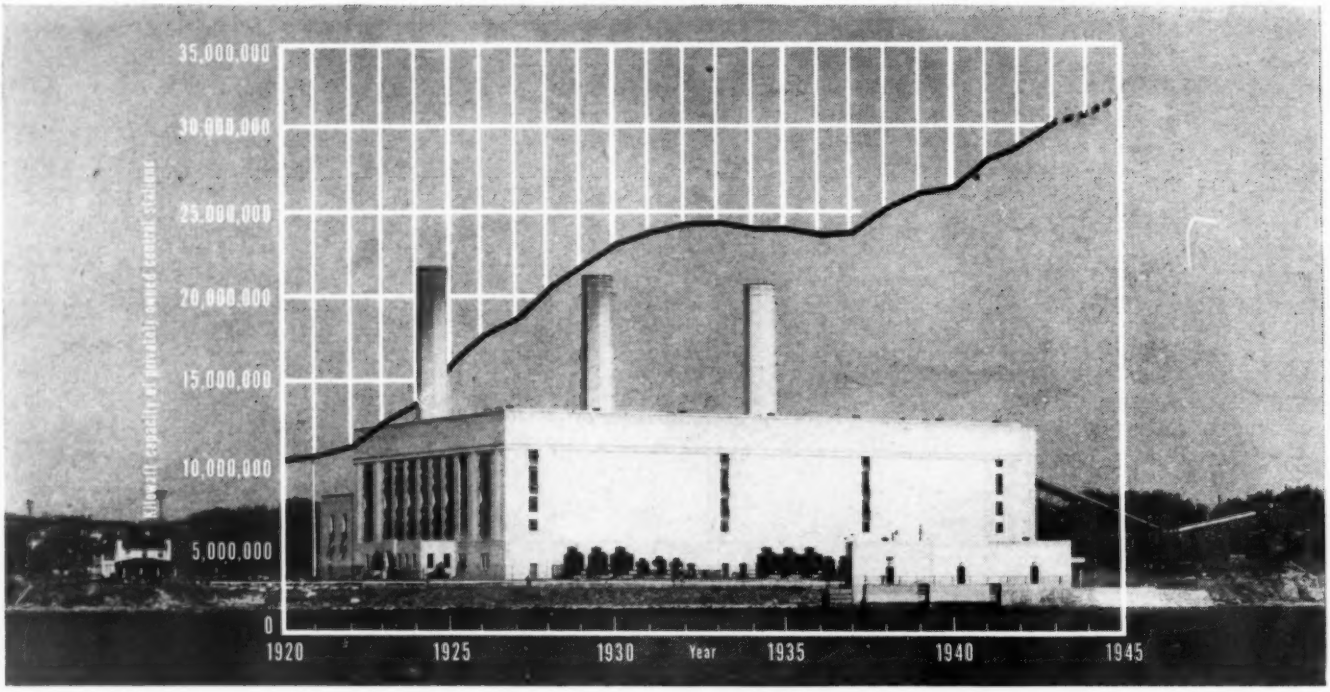
For many years the consumption of both industrial heat (for space warming and process) and industrial power have increased, but power has grown faster than heat. The lesson is clear for those who build or revamp steam plants for by-product power: Select a steam pressure high enough to avoid future exhaust waste.

Higher fuel prices and higher power-plant wages will warrant more dollars for waste-eliminating investments: efficient boilers; versatile steam plants, ample for any available fuel; the best in instruments, meters and controls; adequate insulation; efficient engines, turbines, motors, drives, pumps and compressors; effective heaters and feedwater treatment; good fans and fan controls; tight valves and traps.

Finally, stacks that blacken the sky and spew dust over the countryside won't be tolerated much longer—not in communities accustomed to the otherwise high standards of American living. Wise designers will face this growing challenge now—not wait for ill will and legal action to force costly corrections later.

Taken altogether, the outlook for progressive power men is very good—a chance to play a vital part in the vastly expanded operations of this great industrial nation—the most successful co-operative venture of all history.

Central Station Capacity



Completed in 1945 Buzzard Point with six boilers and six turbine-generators has total installed capacity of 270,000 kw

During 1944 fuel-fired plants installed 770,449-kw new capacity and in 1945 scheduled 745,793-kw additional, with more planned for 1946 and 1947 according to Federal Power Commission. Here are briefs on 43 plants with recent additions, and new and projected construction as collected by Assistant Editor B G A Skrotzki, with cooperation of utility engineers

ARKWRIGHT — Georgia Power Co: Three units arranged for isolated operation, each consisting of a 40,000-kw turbine-generator operating at 800 psi, 850 F, are fed by a 400,000-lb-per-hr boiler. They were placed in operation on June 1941, May 1942 and Sept 1943 respectively. Heat balance of each uses three closed heaters and features 80-psig feedwater deaeration with makeup evaporated from river water.

Units 1 and 2 have Westinghouse turbine-generators and Combustion Engineering boilers, while Unit 3 has General Electric turbine-generators and Babcock & Wilcox boilers; all have Elliott surface condensers. Provision is made for installation of future fourth unit.

ARTHUR KILL—Staten Island Edison Co: Work has been started at this new station on installation of two Foster-Wheeler 120,000-lb-per-hr boilers supplying a Westinghouse 20,000-kw 850-psig 900-F turbine-generator. Gilbert Associates are consulting engineers.

ATKINSON—Georgia Power Co: Scheduled for operation in the fall of 1945, Unit 3 consists of a Westinghouse 60,000-kw 850-psig 900-F turbine-generator fed by a Combustion Engineering 600,000-lb-per-hr boiler. Unit will be completely isolated from existing 425-psig 750-F units.

Three closed heaters (Westinghouse) and one deaerating heater (Elliott) operating at 80 psig comprise major feed-heating equipment. Surface condenser supplied by C H Wheeler Manufacturing; and fans by Sturtevant. Space is available for possible future fourth unit.

ATLANTIC CITY—American Gas and Electric Co: Expected to start in the summer of 1946 a General Electric 25,000-kw turbine supplied by a Foster-Wheeler 300,000-lb-per-hr boiler features throttle steam conditions of 1350 psig and 1000 F.

BENNING—Potomac Electric Power Co: Construction was started in fall of 1945 on complete new 50,000-kw turbine-generator and boiler. General Electric turbine will operate at 650 psig, 900 F and 1800 rpm, have four extraction stages for feed heating.

Scheduled to start operating spring of 1947 with Stone & Webster handling design and construction.

R E BURGER—Ohio Public Service Co: First unit, placed in operation Feb 1944, will be followed in late 1946 by unit of similar rating now under construction. Turbine-generator, rated at 60,000 kw, 900 psig, 900 F, hydrogen cooled, is supplied by two pulverized-coal-fired 350,000-lb-per-hr boilers.

BUZZARD POINT—Potomac Electric Power Co: During summer of 1945 starting operation of the sixth unit completed station construction. General Electric 50,000-kw turbine-generator operating at 650 psig, 900 F, 1800 rpm provides four stages of feedwater heating in direct-contact heaters. Boiler by Combustion

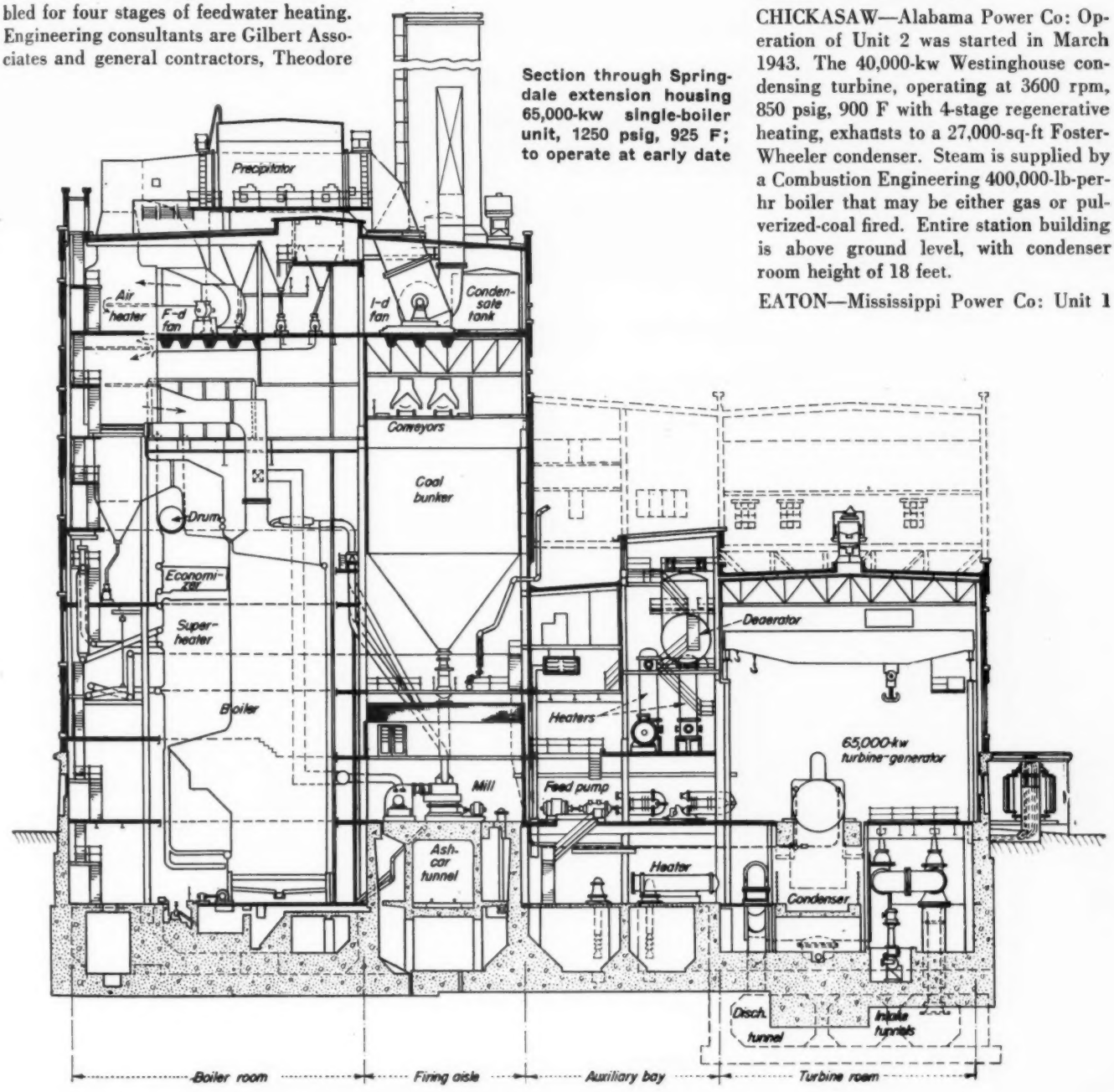
Continues Expansion

Engineering supplies 525,000 lb per hr steam. To minimize flyash discharge in Washington, D. C. area Cottrell precipitators have three sections in series instead of usual two. Consulting and construction engineering by Stone & Webster Engineering Corp.

CANNON STREET—New Bedford Gas and Edison Light Co: Three small units with their boilers are now being removed to install a Westinghouse 20,000-kw 850-psig 900-F condensing turbine-generator and two Foster-Wheeler 120,000-lb-per-hr boilers. Boilers are designed for pulverized-coal and oil-firing. Turbine will be bled for four stages of feedwater heating. Engineering consultants are Gilbert Associates and general contractors, Theodore Langer and Sons. Turbine-generator and first boiler scheduled to operate June 1946, with second boiler coming in September 1946.

CHESTER—Philadelphia Electric Co: Following completion of the 1250-psig 925-F, 50,000-kw topping unit installation in 1941 a 250-psig 570-F 80,000-kw 1800-rpm condensing unit was placed in operation in Nov 1942. No new boilers were installed with the latter turbine, the capacity released by installing a topper is adequate for new low-pressure machine.

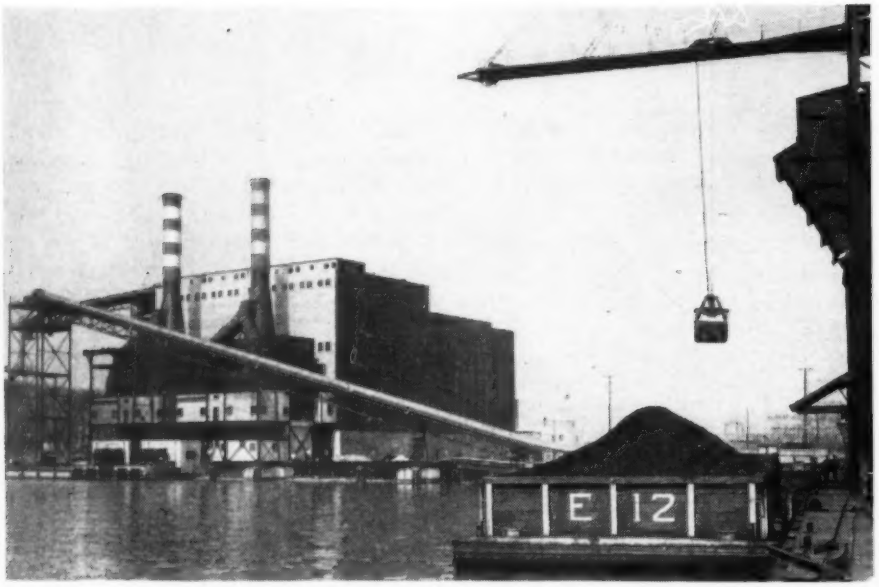
Section through Springdale extension housing 65,000-kw single-boiler unit, 1250 psig, 925 F; to operate at early date



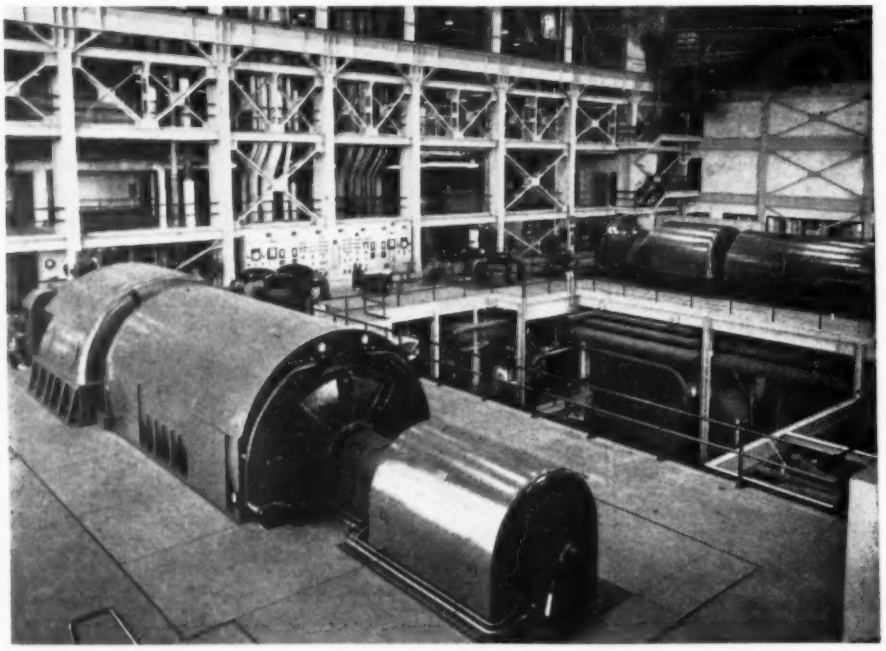
CHESTERFIELD—Virginia Electric and Power Co: Preliminary construction started May 1942 on the first unit was 98% complete on the starting date July 31, 1944. A Combustion Engineering 525,000-lb-per-hr boiler feeds a General Electric 50,000-kw 850-psig 900-F condensing turbine-generator provided with four bleed points. Feedwater heated in three stages and makeup supplied through evaporators. Station and equipment design was strongly influenced by the critical-material conservation program caused by the war. Stone & Webster were engineers and consultants.

CHICKASAW—Alabama Power Co: Operation of Unit 2 was started in March 1943. The 40,000-kw Westinghouse condensing turbine, operating at 3600 rpm, 850 psig, 900 F with 4-stage regenerative heating, exhausts to a 27,000-sq-ft Foster-Wheeler condenser. Steam is supplied by a Combustion Engineering 400,000-lb-per-hr boiler that may be either gas or pulverized-coal fired. Entire station building is above ground level, with condenser room height of 18 feet.

EATON—Mississippi Power Co: Unit 1



Riverside operating at 850 psig, 900 F with two units will ultimately have six



Two 60,000-kw turbines of Riverside placed in operation Dec 1942 and April 1944

placed in operation April 1945, has a General Electric 22,500-kw condensing turbine-generator, hydrogen cooled. The Riley Stoker boiler is designed for 975-psig maximum working pressure to deliver 230,000 lb per hr of steam. Unit 2 of the same capacity and characteristics was scheduled for construction initiation on Oct 1945 and operation early in 1947.

GORGAS NO. 2—Alabama Power Co: Unit 2 initially operated in Jan 1944 consists of a General Electric 60,000-kw 850-psig 900-F condensing turbine driving a hydrogen-cooled generator at 3600 rpm. Turbine steam exhausts into a C H Wheeler 47,000-sq ft 2-pass surface condenser. Steam supplied by Combustion Engineering pulverized-coal-fired 600,000-lb-per-hr steam boiler. Feedwater heated in 4-stage regenerative cycle includes one deaerating heater. Unit firing equipment in plant originally planned for central firing without major architectural changes.

GRAND AVENUE—Kansas City Power & Light Co: In Dec 1944 a Combustion Engineering 350,000-lb-per-hr boiler installation was completed. Built for ultimate operation at 700 psig and 950 F it now runs with a modified superheater to produce 750-F steam until a new turbine designed for the rated temperature is installed. No economizer was provided since regenerative cycle heating would raise feedwater to 370 F. A Westinghouse 35,000-kw 650-psig 950-F turbine-generator on order is scheduled for initial operation in early 1947.

HARDING STREET — Indianapolis Power & Light Co: Fourth unit expected to operate initially in Oct 1946 will raise plant rated capacity to 148,500 kw. Combustion Engineering 400,000-lb-per-hr boiler supplies a 37,500-kw 850-psig 900-F General Electric turbine-generator. Installation will duplicate turbine installation of 1941 and boiler installation of 1942. Gibbs & Hill is supervising construction and S T Powell is consultant on water treatment.

HELL GATE—Consolidated Edison Co of New York, Inc: Now being installed are two Babcock & Wilcox direct-fired pulverized-coal 900,000-lb-per-hr continuous rating boilers supplying a General Electric 65,000-kw 900-psig 950-F topping turbine-generator. Major auxiliaries will be turbine driven. Each boiler provided with a pair of induced-draft and a pair of forced-draft fans. Each fan pair driven by a single turbine through reducing gears. Unit is expected to operate initially in early spring of 1946.

HIGH BRIDGE—Northern States Power Co: In the spring of 1942 an additional 50,000-kw unit was installed followed by a second identical addition in the spring of 1944. The units consist of General Electric 50,000-kw 850-psig 900-F 3600-rpm hydrogen-cooled turbine-generators supplied by Babcock & Wilcox 570,000-lb-per-hr pulverized-coal and natural-gas-fired boilers. Two deaerators taking steam from the 14th stage of each turbine operate in parallel and are part of the regenerative-cycle heating arrangement.

HORSESHOE LAKE—Oklahoma Gas & Electric Co: Now under construction and scheduled for initial operation in summer of 1946 is a topping unit of semi-outdoor design. A Babcock & Wilcox 300,000-lb-per-hr boiler supplies a General Electric 10,000-kw 1250-psig 950-F turbine-generator exhausting at 300 psig, 700 F. Feedwater will be taken directly from existing heaters of the low-pressure units; no cross-over heater will be provided. Public Utility Engineering and Service Corp of Chicago are project engineers.

JENNISON—New York State Electric & Gas Corp: A new station initially operated Oct 1945 contains two Combustion Engineering 200,000-lb-per-hr boilers supplying a General Electric 30,000-kw 650-psig 825-F 3600-rpm hydrogen-cooled turbine generator. Steam generators are

GENERATING UNITS APPROVED FOR INSTALLATION IN 1946—1947

From Federal Power Commission Report

Station	Company	Kw capacity	Station	Company	Kw capacity
Bayside	Wisconsin Public Service Co	30,000	C. S. Lynch	Arkansas Power & Light Co	25,000
Benning	Potomac Electric Power Co	50,000	Manchester St	Narragansett Electric Co	40,000
Burger	Ohio River Power Co	60,000	Market St	New Orleans Public Service Co	30,000
Calumet	Commonwealth Edison Co	107,000	Marysville	Detroit Edison Co	75,000
Charleston	South Carolina Power Co	22,500	Meredosia	Central Illinois Public Service Co	50,000
Crookston, Minn	Otter Tail Power Co	5,000	Middletown	Metropolitan Edison Co	35,000
Devil's Lake, N. D.	Otter Tail Power Co	5,000		Long Island Lighting Co	35,000
Devon	Connecticut Light & Power Co	45,000	Mystic	Boston Edison Co	40,000
Eaton	Mississippi Power Co	22,500	New Castle	Pennsylvania Power Co	35,000
El Centro, Calif	Imperial Irrigation District	20,000	Ottawa St	Lansing (Michigan) Municipal System	25,000
Essex	Public Service Elec. & Gas Co. of N. J.	100,000	Paddy's Run	Louisville Gas & Electric Co	50,000
Glendale	Glendale (Calif.) Municipal System	20,000	Port Washington	Wisconsin Electric Power Co	80,000
Grand Ave	Kansas City Power & Light Co	35,000	Rockford	Central Illinois Electric & Gas Co	20,000
Harbor	Los Angeles (Calif.) Municipal System	65,000	San Benito, Tex	Central Power & Light Co	20,000
Harding St	Indianapolis Power & Light Co	37,500	Somerset	Montaup Electric Co	35,000
Havana, Ill	Illinois Power Co	40,000	Suburban	Scranton Electric Co	30,000
Horseshoe Lake	Oklahoma Gas & Electric Co	10,000	Tulsa	Public Service Co. of Oklahoma	20,000
Inglis	Florida Power Corporation	25,000	Tyrone	Kentucky Utilities Co	25,000
Kirk	Sioux City Gas & Electric Co	7,500	Venice	Union Electric Co. of Illinois	80,000
Lieberman	Southwestern Gas & Electric Co	20,000	Waterloo	Iowa Public Service Co	10,000
			West Junction	Houston Lighting & Power Co	37,500

fired by Combustion Lloyd traveling-grate stokers burning No. 4 buckwheat anthracite. Gilbert Associates, Inc, are consulting engineers.

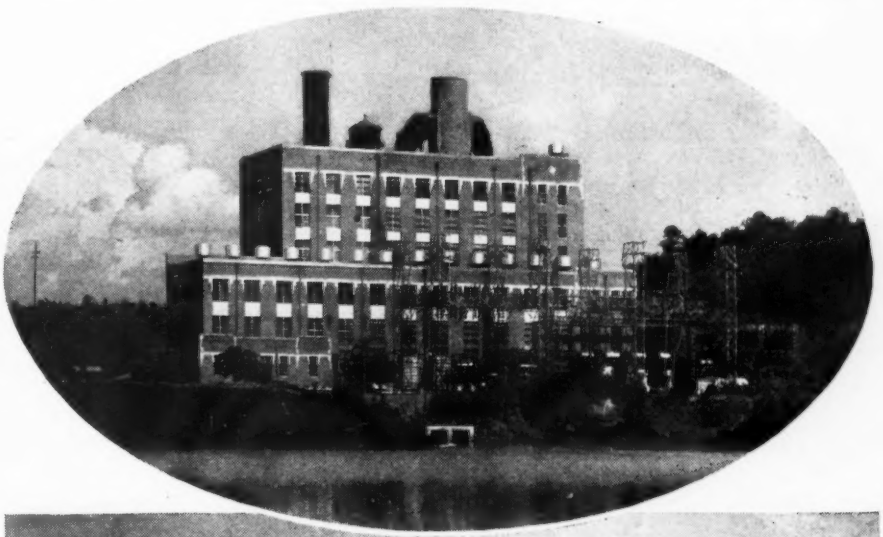
L STREET—Boston Edison Co: In Dec 1941 the boiler, and in Oct 1942 the turbine-generator of a topping unit were placed in service. The General Electric turbine is rated 18,750 kw at 87.5% power factor; it takes steam at 1240 psig, 900 F, which it exhausts at either 320 or 215 psig. The Combustion Engineering boiler is rated at 542,000 lb per hr. Feedwater heating done in a deaerating heater using 55-psig steam exhausted from auxiliary turbines and in a second stage heater using 300-psig steam. Jackson & Moreland were consulting engineers.

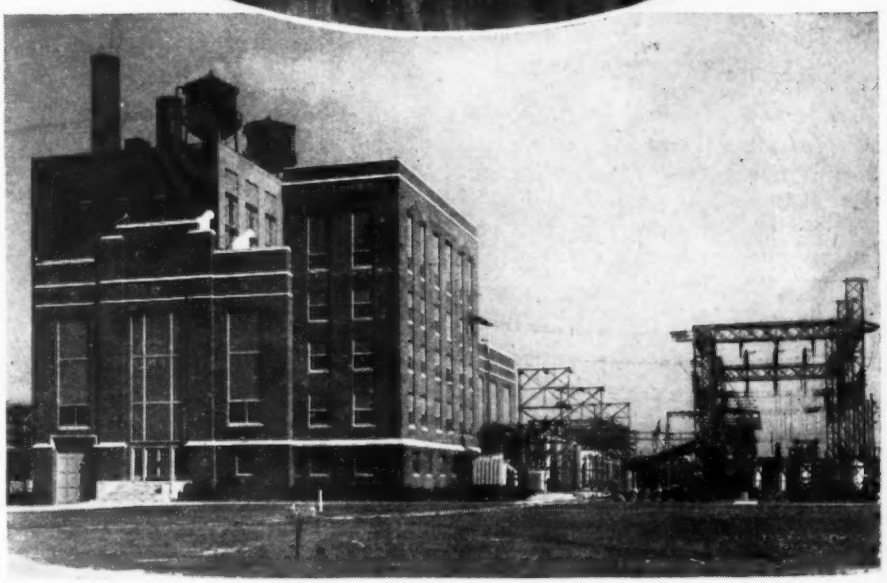
LA PALMA—Central Power and Light Co: An initial starting date late in 1946 is being contemplated for the fourth unit. This will consist of a Babcock & Wilcox 250,000-lb-per-hr integral-type boiler supplying a General Electric 20,000-kw 650-psig 835-F turbine-generator exhausting into a Westinghouse 22,500-sq-ft surface condenser. Feedwater heating will be four stage using a deaerating heater at one of them. Condenser circulating water will be cooled in a Marley tower.

LIEBERMAN — Southwestern Gas & Electric Co: This new station expected to start in Jan 1947 will consist of a Babcock & Wilcox boiler supplying a General Electric 20,000-kw 850-psig 900-F turbine-generator exhausting into a Westinghouse condenser. The boiler will be of the outdoor type while the rest of the plant will be housed in a conventional power plant building. Sargent & Lundy

(*Continued on page* 150)

Gorgas No. 2 had second unit of 60,000-kw capacity operating initially Jan 1944





At Chickasaw 1943 addition was 40,000-kw turbine-generator with single boiler

Man-Made Wind at 130 to -67 F Tests Aircraft-Engine Gasoline Injectors

Here's a story of equipment for low-temperature large-volume air handling and conditioning. In a large research laboratory it created stratospheric conditions that speeded up the adjustment of gasoline injection mechanisms for airplane engines

► BUILT BY Defense Plant Corp at the Springfield, Mass., plant of the American Bosch Corp, the laboratory houses both research and production test departments. Test facilities include one cell in the research and five in the production area. These cells, supplied with conditioned air by blowers and exhausted by vacuum pumps, test the injection mechanisms under different atmospheric conditions.

Each department has its own air-conditioning system, blowers and vacuum pumps so connected that entering air flows through conditioning unit to a blower that discharges it through ceiling outlets into the working area around the cells. Either a high- or low-pressure exhaust blower then takes the room air and passes it through a heater or chilling coil on its way to the test cells. Outlets from test cells connect to vacuum pumps that exhaust to atmosphere.

Adjustable Orifices

Pneumatically operated butterfly valves, fitted with bypasses for increment adjustment in test-cell air ducts are manually adjusted from the test bench to produce the desired pressure inside test cells. Ducts are also equipped with pneumatically operated adjustable metering orifices, which permit measuring small or large air flows without breaking the line and installing a different-sized orifice for each test. Because test air first enters the working space it is conditioned to provide a uniform atmosphere around the intricate meters and instruments.

Each of the two air-conditioning systems has its individual air intake, filters, preheater, air-washing sprays, cooling coil and reheater. City water, seldom exceeding 63 F, serves for initial dry-bulb cooling in summer and humidification in winter. After it passes through precooling and aftercooling coils, the water collects in a sump from which it is pumped through refrigerating condensers and production-department vacuum-pump jackets before going to waste. Cooling coils for primary air conditioning are Freon-12 direct-expansion units fed by an automatic condensing machine in the basement. Steam for preheat and reheat coils comes from the plant heating system.

Except for a difference in air-handling capacity (research department 50,000 lb of air per hr, and production department 80,000 lb) both conditioning systems are designed to discharge air at 65% relative humidity (rh) and 70-F dry-bulb temperature in the summer and 50% rh and 75-F dry-bulb during winter months. Control is by a wet- and dry-bulb temperature recorder that automatically maintains these values within plus or minus 2%. It can be set for any wet- and dry-bulb combination desired. A bypass return to the air washers permits recirculating 25,000 cfm throughout the workroom when test-cell use is low or nil.

Research test cell requires a maximum of 50,000 lb of air per hr at temperatures ranging from 70 to 130 F, or 25,000 lb from 70 to −67 F. Automatic control holds the temperature within plus or minus 2%. Air from the working space exhausts into a plenum chamber that feeds either a low-pressure (one atmosphere) or high-pressure (40 in. Hg) blower. Discharge duct from each unit carries an aftercooler supplied with city water to remove the heat of compression. Beyond each aftercooler, discharge lines go to a common duct fitted with a steam-heating coil. This connects to the ammonia refrigerating unit and a bypass around the latter. From here the duct

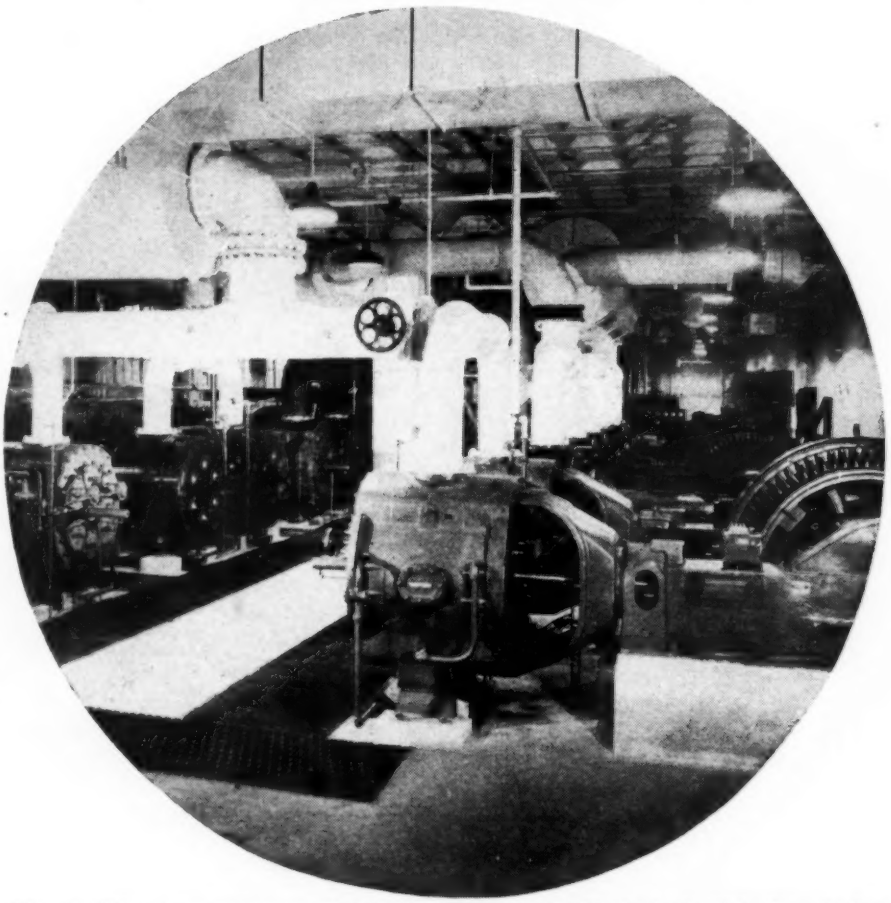


Fig. 1—Nine vacuum pumps (total displacement 43,200 cfm) stand in two facing rows on foundation mats supported by sheet cork to prevent any building vibration

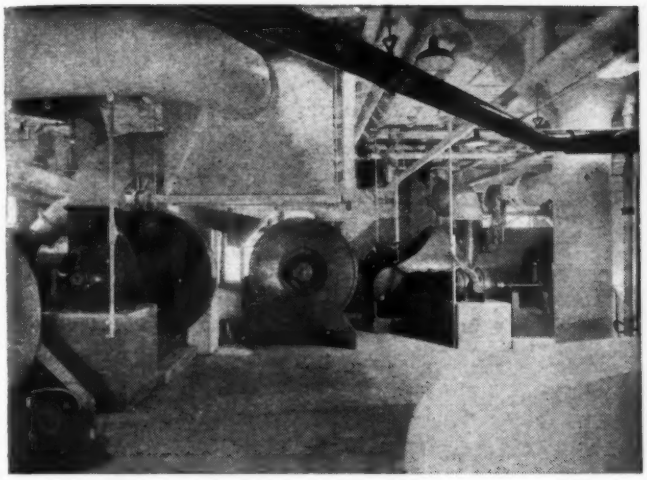


Fig. 2—Air supply to test cells comes from these low-pressure (left center) and high-pressure (center and right center) blowers. Aftercooler hangs above the foreground blowers

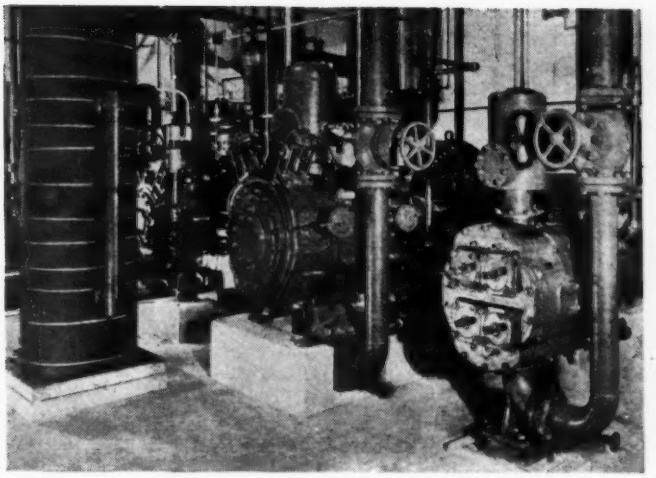


Fig. 3—Ammonia compressors, grouped together in one corner of the basement, stand on an isolated foundation pad. The intercooler and duplex machine are shown at the left

runs directly to the laboratory test cell.

Static pressure in supply duct is regulated automatically, by a pressurestat that operates a butterfly valve in blower discharge, within plus or minus 1% between atmospheric pressure and 20 psia for all flows from 10 to 100% of maximum. Duct arrangement and butterfly-valve locations are such that warm, heated or chilled air can be fed to the test cell by retaining the heat of compression, applying steam to the heating coil or removing the heat of compression and passing the air over the ammonia refrigerating unit.

This unit has four stages housed in an enlarged section of the duct. Each stage consists of two banks of coils and two accumulators, one mounted above the other, and so connected that overflow of ammonia from the upper keeps the lower accumulator liquid level at the proper height. Thus only one float control is needed to regulate ammonia flow to the two banks of coils. Both temperature and suction-pressure controllers on the evaporators operate compressor clearance-pocket valves to regulate compressor load. Units are started and stopped manually; when started the variable-speed motor controller is positioned to cover the approximate load range.

First stage cools the air to 35 F using a 6x6-in. single-stage single-cylinder 30.2-ton compressor; second stage cools air to −10 F with a 10x10-in. single-stage single-cylinder 37-ton compressor; third stage cools to −45 F with an 18- and 9¼x12-in. duplex 2-stage 27-ton unit; fourth stage cools to −75 with an 18x7-in. single-cylinder 13.1-ton booster compressor that discharges into the suction of third-stage unit.

Since practically all moisture precipitates in the −10 F zone, some provision had to be made to prevent frost accumulation on the coils. This is taken care of by spraying glycol on the coils where it mixes with the moisture and carries it to a regenerating unit. Here it is boiled off and the glycol is again pumped to the sprays for reuse.

The extremely low temperatures provided by this unit introduced the problem of trying to fit exceptionally thick insulation to small lines and accumulators closely adjacent to each other. This difficulty was overcome by totally inclosing the expanded section of duct containing the evaporators in a housing of corkboard walls 10 in. thick. A partition of the same material stands between the second and third stages and access doors at each end permit workmen to enter and inspect or repair individual parts without removing obstructing insulation.

Test-cell exhaust duct continues down to the basement where it connects through silencers to two duplex 34- and 34x14-in. 225-rpm 6600-cfm 225-hp vacuum pumps connected in parallel. Discharge passes through a silencer to atmosphere. Static pressure in the line between test cell and vacuum pumps is controlled automatically within plus or minus 1% between 8 psia and atmospheric pressure for all flows from 10 to 100% of maximum. Disturbances from sudden changes in flow are corrected within 30 sec. A pressurestat-operated vent valve in the same line, set for minimum operating pressure, prevents the vacuum pumps being operated at extremely low suction pressure if line valves are closed.

Because the vacuum pumps handle ex-

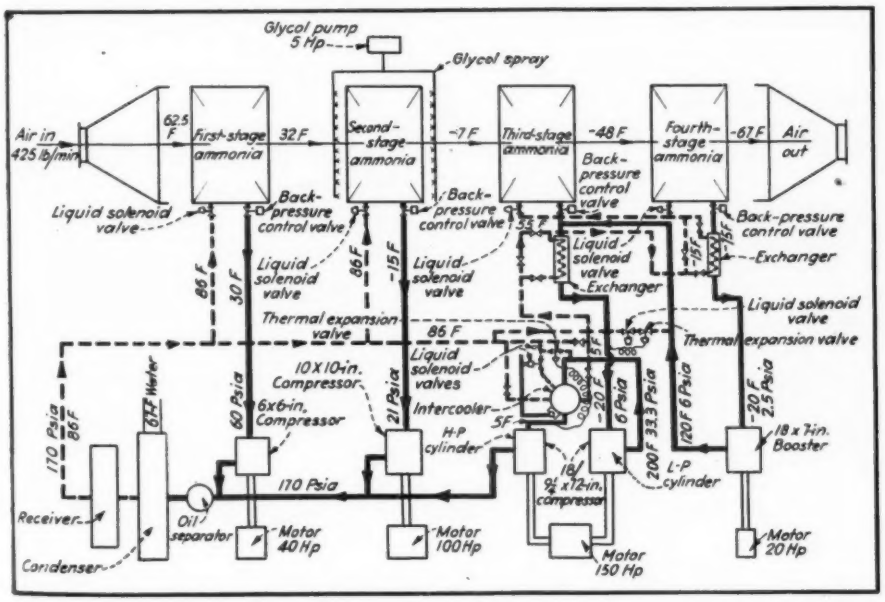


Fig. 4—This refrigerating system uses liquid-gas heat exchangers on the last two stages and an ammonia-cooled intercooler for the duplex 2-stage compressor

tremely cold air, water cannot be used in the cylinder jackets. Instead, glycol is circulated in a closed system between the jackets and a hot-water heat exchanger. Before entering the heat exchanger the water passes through steam-heating coils that warm it to 85 F. A thermostatic valve in the steam line, controlled by a bulb attached to the glycol discharge line from heat exchanger, maintains the glycol at 80 F as it goes to cylinder jackets.

Production test department requires 80,000 lb of air per hr and, except for the absence of a refrigerating unit, duct work, valve arrangement and automatic control in the primary air supply are similar to those in the research layout. System is designed to deliver 40,000 lb of air per hr to each of two test cells or 25,000 lb per hr to each of three cells. Low- and high-pressure blowers can operate in parallel if needed. Exhaust from each of two test cells connects to two duplex 32- and 32x14-in. 225-rpm 200-hp 5850-cfm vacuum pumps. Three duplex 34- and 34x14-in. 225-rpm 225-hp 6600-cfm vacuum units take care of the remaining test cells.

The nine vacuum pumps, in the basement, stand in two rows facing across a 12-ft passageway. Each row stands on a common foundation slab that rests on cork mats that prevent machine vibration reaching the building structure. Since all units run at the same speed with synchronous motors two or more can get in step and greatly amplify the individual shaking forces. For this reason foundation was constructed by excavating a pit 6 ft deep and lining it with 12 in. of concrete.

Floor and walls were covered with a ⅝-in. layer of waterproofing compound and side walls fitted with a 1-in. layer of corkboard, which was also waterproofed. Rows of 2-in. corkboard were laid on the concrete floor and uniformly distributed to carry a load of 800 to 1000 lb per sq ft. The cork was then covered with tight-fitting sheets of asbestos board and the foundation concrete poured on top. Refrigerating compressors have same foundation construction except that this pit is only 2½ ft deep.

Electrical Service

Electrical power at 13.8 kv comes into a special fire-protected vault from an outside switch house owned by the power company. Power is transmitted from the switch house to the electrical vault through a 15-kv 3-conductor No. 2-0 varnished-cambric lead-covered cable. Reaching the electrical vault the power cable terminates in another 3-compartment metalclad switchgear unit consisting of two oil-circuit-breaker compartments and one pothead and instrument-transformer compartment. One circuit-breaker compartment feeds the 2500-kva 13.8- to 2.3-kv delta-connected main power transformer. The latter is air cooled and filled with Inerteen for fire protection. Other circuit-breaker compartment feeds a 750-kva 13,800- to 480-v air-cooled Inerteen-filled auxiliary power transformer. Both circuit breakers are 3-pole 600-amp 15,000-v de-ion grid type, each provided with overcurrent relays.

Electricity from the main power transformer is distributed at 2300 v from a 2-compartment metalclad switchgear unit to three groups of synchronous motors. First group consists of five motors and the second of four motors that operate the vacuum pumps. Third group —two synchronous motors—drives the high-pressure air blowers. Vacuum-pump motors are reduced-voltage starting, automatically controlled from pushbutton stations located at each pump or on front of the respective panels. Motors are protected against overload, undervoltage and loss of field. Control and protection for blower motors is similar except that they are manually controlled.

Electricity at 480 v from the auxiliary-power transformer feeds a 6-compartment air-circuit-breaker bank of switchgear that supplies power feeder panels. All 480-v power is distributed through these circuit breakers to smaller dead-front power panels or control boards for auxiliary motors and power equipment. Standard thermal overload and undervoltage protection is provided for the motors, some of which are across-the-line starting. The wound-rotor induction motors on the ammonia compressors, however, start at reduced voltage.

Arthur E Magher Co, Inc, New York, worked with American Bosch Corp engineers on design and installation of the complete air-handling and conditioning system. Ernest F Carlson, Springfield, Mass., designed and built both the building and plumbing and heating systems.

PRINCIPAL AIR-CONDITIONING EQUIPMENT

American Bosch Corp, Springfield, Mass.

AIR-CONDITIONING EQUIPMENT:

Freon flow regulator	Alco Valve Co
Direct-expansion coil	Clarage Fan Co
Temperature and humidity control	Johnson Service Co
Steam pressure-reducing valves	Mueller Co
Freon compressors and condenser	Worthington Pump & Mach Corp
Temperature indicators	Brown Instrument Co
Gages	U. S. Gauge Co

AIR-HANDLING EQUIPMENT:

High-pressure blowers	Spencer Turbine Co
Low-pressure blowers	Clarage Fan Co
Aftercoolers and heater	Walsh Boiler Works
Manually operated valves	Chapman Valve Mfg Co
Butterfly valves	R-S Products Corp
Butterfly-valve operators	Republic Flow Meters Co
Rubber expansion joints	U. S. Rubber Co
Silencers	The Maxim Silencer Co
Foundation cork	Armstrong Cork Co
Vacuum pumps (3) 34 and 34x14 in., 6600 cfm, 225 rpm, 225 hp	Ingersoll-Rand Co
Vacuum pumps (2) 32 and 32x14 in., 5850 cfm, 225 rpm, 200 hp	Ingersoll-Rand Co
Vacuum pumps (2) 32 and 32x14 in., 5850 cfm, 225 rpm, 220 hp	Worthington Pump & Mach Corp
Machinery-room sump pump	Yeomans Bros Co
Glycol heat exchanger	Sims Co
Glycol pump	Worthington Pump & Mach Corp

REFRIGERATING EQUIPMENT:

Ammonia compressors	Worthington Pump & Mach Corp
Ammonia condenser	Worthington Pump & Mach Corp
Glycol spray pump	Worthington Pump & Mach Corp
Ammonia evaporators	Walsh Boiler Works
Cork cabinet	Armstrong Cork Co
Glycol regenerator	Worthington Pump & Mach Corp
Glycol float control	Fisher Governor Co
Glycol temperature control	Sarco Co Inc
Glycol liquid-level switch	Alco Valve Co
Glycol flow indicators	Fischer & Porter Co
Air compressor for control 9x7 in., 600 rpm, 100 psi	Sullivan Machinery Co

ELECTRICAL EQUIPMENT:

Air-compressor motor	Westinghouse Elec Corp
Switchgear	Westinghouse Elec Corp
Power transformers	Westinghouse Elec Corp
Lighting transformer	Uptegraff Mfg Co
Control and switchboards	General Elec Co; Westinghouse Elec Corp
Vacuum-pump motors (5)	General Electric Co
Vacuum-pump motors (4)	Westinghouse Elec Corp
Motor-generator sets	Columbia Elec Mfg Corp; General Elec Co; Westinghouse Elec Corp
Ammonia-compressor motors	Westinghouse Elec Corp
Freon-compressor motors	Wagner Elec Corp
Low-pressure-blower motors	Westinghouse Elec Corp
High-pressure-blower motors	Westinghouse Elec Corp

Gas-Diesel Principle Applied to Supercharged and 2-Cycle Engines

Ralph Boyer, chief engineer, Cooper-Bessemer Corp, reports on development of atmospheric and supercharged 4-cycle gas-diesels and application of this principle to 2-cycle units, with special reference to valving, injection and controls

▶ ADVENT OF THE GAS-DIESEL, able to burn gas fuel with diesel-cycle efficiency and to operate on combinations of oil and gas fuel, naturally evoked widespread interest and much discussion regarding the history of this development. Tracing general history is not my purpose here but rather to report progress of the line of development with which I am most familiar, a line that includes application of the gas-diesel principle to 2-cycle engines as well as 4-cycle and to both atmospheric and supercharged engines.

The first gas-diesel, to my knowledge, was designed in 1927 and operated successfully at Cooper-Bessemer in 1928. It was a 12x16-in. 300-rpm 2-cycle engine, the piston underside and crosshead topside pumping scavenging air. Fig. 1 shows a cross-section of this experimental unit.

The original Cooper-Bessemer engine, as well as subsequent developments, centered around high-pressure gas injection. It had not occurred to us that fuel gas could be admitted with intake air and the mixture compressed to high levels. In fact, we knew at that time it couldn't be done, because compression pressures of more than about 125 psi could not be used on any of our standard gas engines. We now know that gas-air mixtures can be compressed to full diesel pressure levels without pre-ignition. What makes this possible?

Actually there is no mystery; it is simply a matter of gas-air ratio. In contrast to the otto cycle of the standard gas engine, the diesel cycle operates with a considerable amount of excess air; so even at full load the mixture is quite lean. At partial loads it is even leaner because the diesel admits a full charge of air at all times. Thus the ratio is such that the mixture will not fire at all until considerable flame energy is applied in the form of pilot-oil combustion.

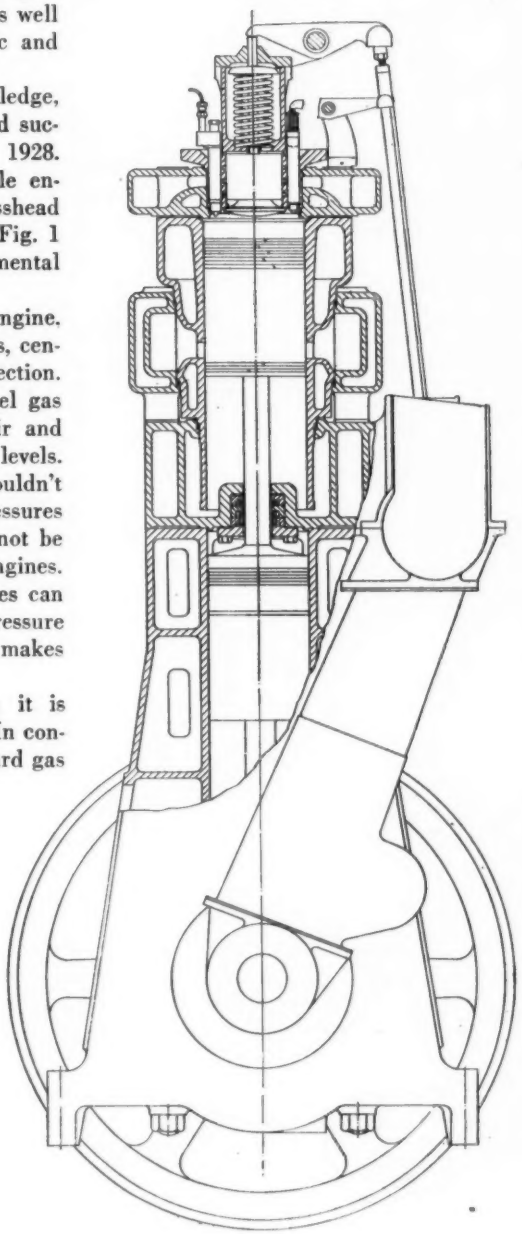


Fig. 1—Experimental 12x16-in. 300-rpm 2-cycle gas-diesel designed in 1927 and operated in 1928. Piston underside and crosshead topside pumped scavenging air. Air alone was compressed; high-pressure gas was injected near the end of the compression stroke

Gas-diesel development at Cooper-Bessemer has followed three lines, each with its own problems and characteristics: (1) 4-cycle atmospheric (2) 4-cycle supercharged (3) 2-cycle.

By this time, most engineers know of pioneer developments in England using low-pressure gas and are familiar with the fact that these engines employed intake valves, which not only opened the air passage but also admitted gas. Using this gas-admission arrangement means that the gas-diesel cylinder head is entirely different from that of a standard diesel. Because the gas-diesel development appeared to offer attractive possibilities for conversion of existing oil engines we centered our program around simplicity, not only for more economical application to engines in production but also to make possible application of the gas-diesel principle to diesels already in the field.

Experiments on various forms of gas admission led to the simple arrangement of Fig. 2. Theoretically this is not ideal since the gas flows into the intake passage continuously while the valve is closed. Actually, however, gas and air mix completely and there is no evidence of stratification. This form is now standard on all Cooper-Bessemer models, available in several sizes. Fig. 3 shows a JS engine, rated 770 hp at 450 rpm, and Fig. 4 shows fuel-consumption performance. These fuel-economy data may be considered typical of the GS and LS engines, also available as gas-diesels.

Almost daily someone asks, "Can the gas-diesel be rated as high as the spark-

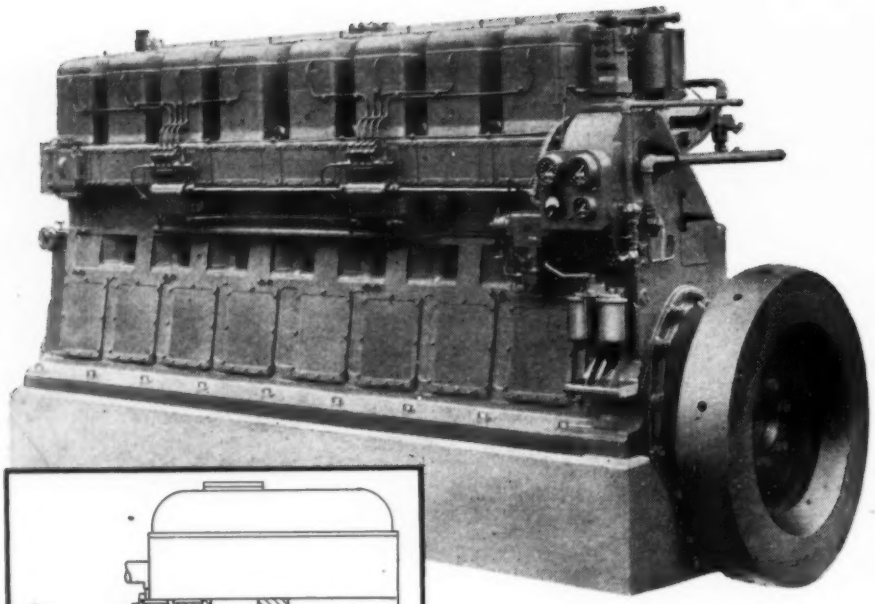


Fig. 3 (above)—Atmospheric gas-diesel with eight 13x16-in. cylinders, rated at 770 hp, when operating at 450 rpm

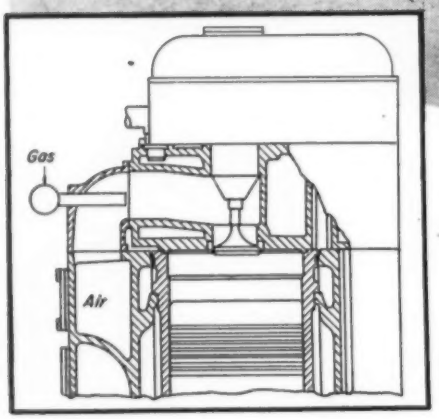


Fig. 2 (left)—Section shows how gas from header enters an elbow connecting the air manifold to the cylinder head

ignited gas engine or as the conventional diesel?" Our experience shows that the gas-diesel can be rated as equal to the oil engine, and by arranging for an increased amount of fuel oil for overload conditions only, it is capable of much greater overloads than the normal diesel. We currently rate the atmospheric gas-diesel at 80-psi bmep.

Applying the gas-diesel principle to a supercharged engine requires somewhat more complication than in the atmospheric engine, since it no longer proves possible to admit gas by the simple means of Fig. 2. In supercharged engines both inlet and exhaust valves are open during the scavenging period, and air under pressure blows through the cylinder into the exhaust system to clear out unburned gas. If fuel gas were admitted in the simple manner of Fig. 2, some would be carried through the cylinder and out the exhaust unburned.

It is, therefore, necessary to time gas admission so it begins about the time the exhaust valve closes and all of it is trapped in the cylinder. For that purpose we employ a gas timing valve, shown diagrammatically in Fig. 6, which is operated by the inlet and exhaust cams but which injects gas into the intake air stream rather than into the cylinder. Foreseeing the necessity of this timing, we applied for and received a patent covering this in general. Fig. 7 shows a typical supercharged engine, one of several sizes now available.

Fuel-consumption curves for supercharged gas-diesels differ in shape from those of atmospheric engines. Supercharged engines show lower fuel consumption not only at full but at partial loads also, being always lower than the atmospheric engine, even at the same bmep. Fig. 5 illustrates a typical performance curve for a supercharged engine.

At 130 bmep in Fig. 5, total heat consumption of this engine was only 6350 Btu per bhphr, representing brake thermal efficiency of over 40%, based on the fuel's lower heating value, as is standard gas-engine practice. This may very well represent a record efficiency for a heat engine, although no particular attempt was made to break any records. The engine on which this test was run carried all its own auxiliaries. We now know that this figure can be improved and believe that a net heat rate of 6000 Btu per bhphr is entirely possible.

As with the 4-cycle atmospheric engine, recommended ratings for supercharged gas-diesels run the same as for supercharged oil-diesels. We currently rate them at about 115-psi bmep for heavy-duty applications.

Two-cycle gas engines power a large percentage of gas compressors today. Pipeline engineers find attractive the possibility of conserving fuel by higher engine efficiency and also appreciate the

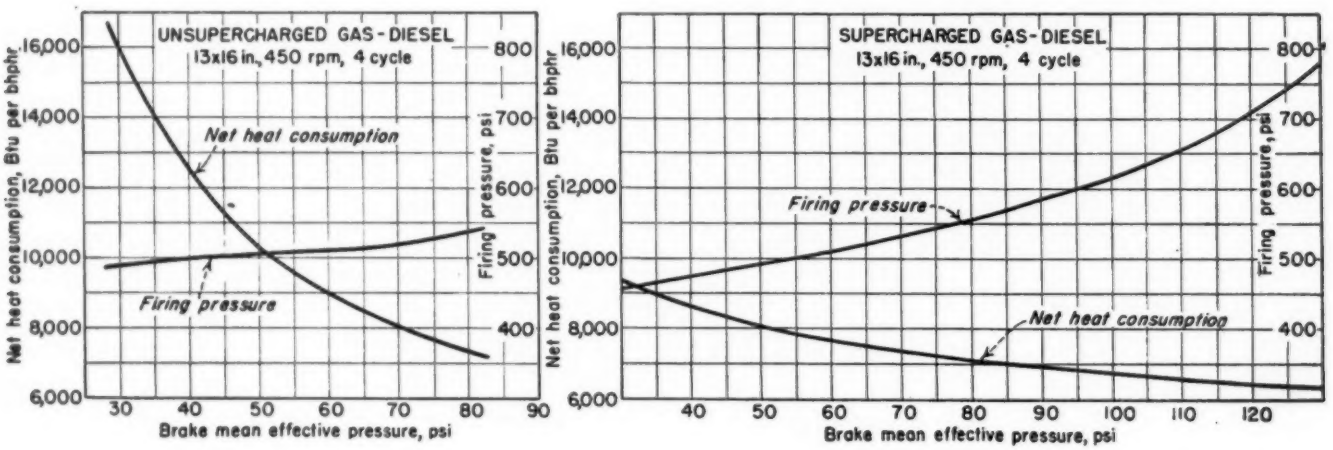


Fig. 4—Net-heat-consumption and firing-pressure curves for atmospheric gas-diesel. Fig. 5 (right)—Similar data for supercharged gas-diesel. Note that supercharging betters performance at any given bmep, particularly at low loads

ability to convert engines to oil fuel in winter when gas supply is low. To meet this need, we carried 2-cycle development along with 4-cycle.

The 2-cycle gas-diesel presents the same timing problem as the supercharged 4-cycle and an additional scavenging problem. Although we consider our development of the 2-cycle gas-diesel as far from complete today, we have built some engines and include here a report on this type to answer the many questions that arise.

Our standard gas-engine practice involves injecting gas into the cylinder at about the time exhaust ports close. Since all air is already in the cylinder the gas cannot be admitted with the air, and effectiveness of mixing depends entirely on gas velocity plus air turbulence. Thus, in the gas-diesel gas must be injected into the cylinder rather than into the air stream as in 4-cycle engines. Fig. 8 shows the novel arrangement which accomplishes this, and on which patents are pending. Fig. 9 illustrates the cylinder-head construction of a 14x14-in. Type-GMV 2-cycle engine.

Fuel-consumption curves for 2-cycle engines display much the same characteristics as those for 4-cycle units. Fuel consumption at full load is higher than for 4-cycle engines but that is because the 2-cycle engine is rated at lower bmep. At any given bmep, 2-cycle performance runs better than that of 4-cycle atmospheric engines.

Fig. 10 shows a typical fuel-consumption curve for a GMV engine; normal rating is about 62-psi bmep. At the present stage of development it is entirely possible to carry that rating with some overload capacity and without any detonation. To do it, however, requires (1) a somewhat greater amount of scavenging air than normally used with a spark-ignited 2-cycle engine, or (2) a greater percentage of pilot oil.

If scavenging pressure runs too low or fuel-oil percentage is not high enough, the flame-propagation wave from the pilot injection frequently sets off a pocket of richer mixture due to stratification. Contrary to what one might expect, we have had no difficulty with pre-ignition. By increasing air turbulence we have cut fuel-oil percentage to less than 4%. On the other hand, by increasing fuel-oil percentage to about 20%, normal full load

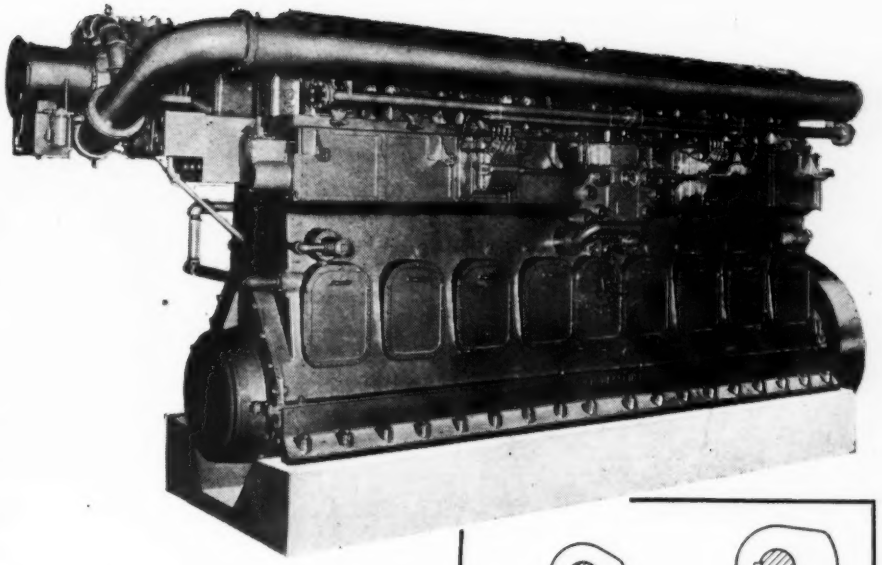


Fig. 7 (above)—This supercharged gas-diesel is rated at 1570 hp for 327 rpm

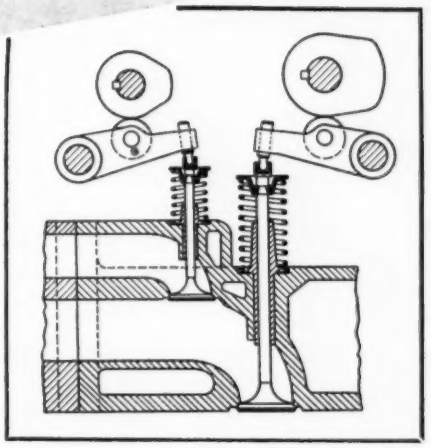


Fig. 6 (right)—Diagram shows how timing valve controls gas admission to inlet air stream so that no fuel is wasted by entering cylinder during scavenging

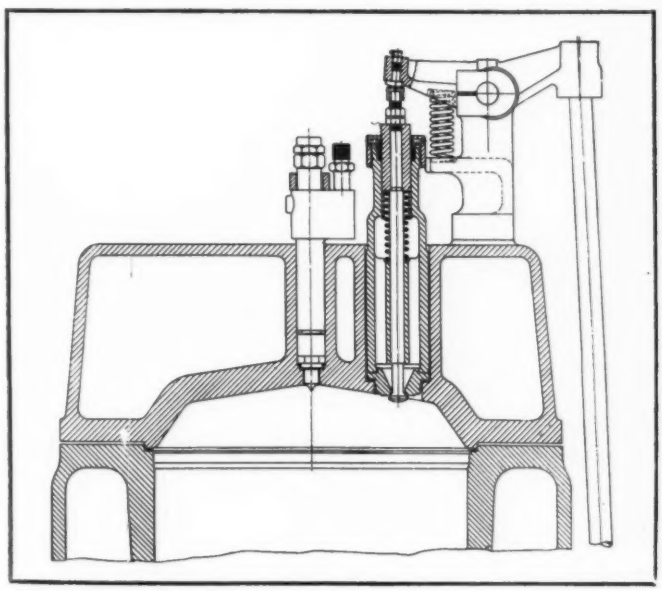


Fig. 8—Arrangement for injecting fuel gas into cylinder of 2-cycle gas-diesel at or near end of the scavenging period

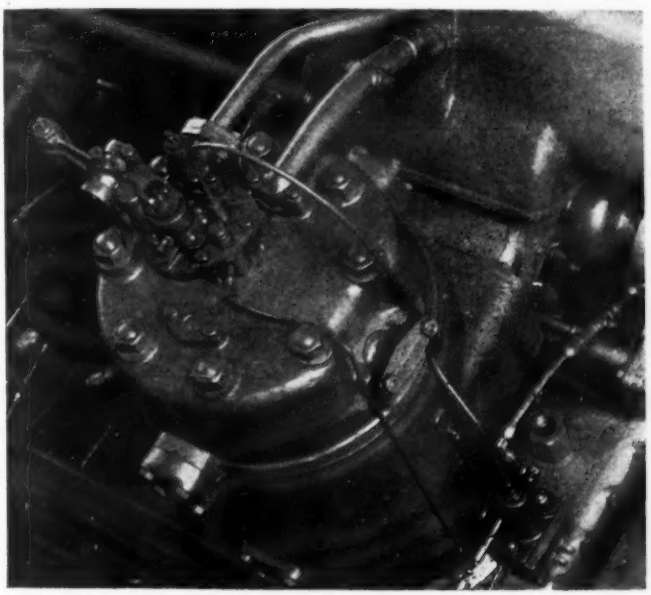


Fig. 9—Cylinder-head construction of a 14x14-in. 2-cycle engine of the GMV type widely used in compressor stations

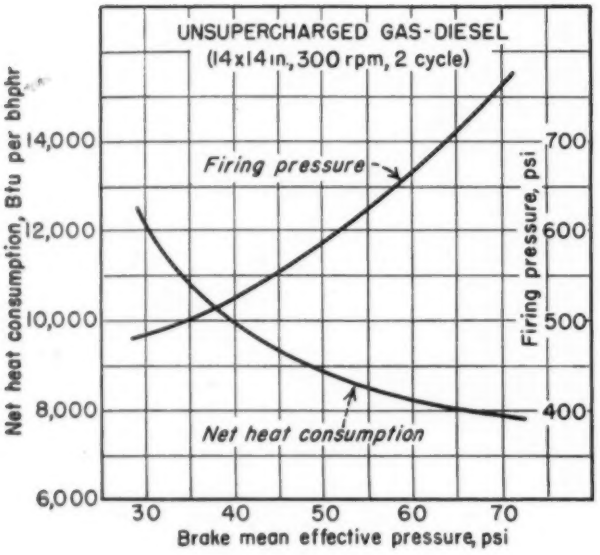


Fig. 10—Net heat consumption and firing pressure, 2-cycle gas-diesel. At any given bmep, performance betters 4-cycle

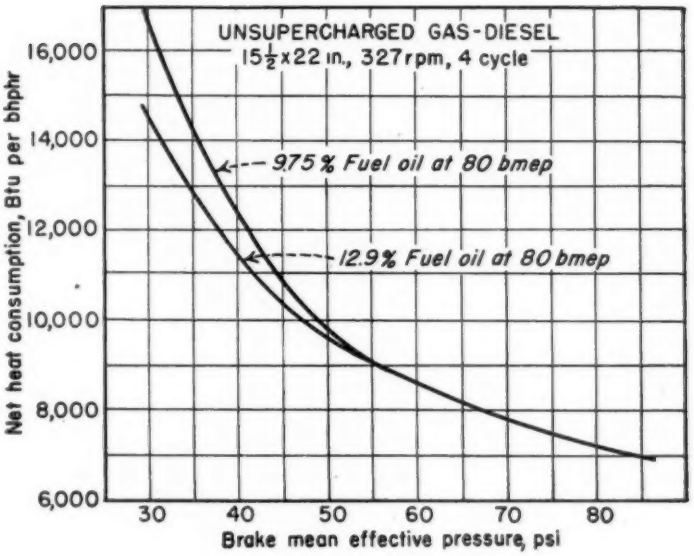


Fig. 11—Two runs on same engine with different fuel-oil percentages show that effect is felt most at lighter loads

can be carried with a minimum of scavenging and turbulence.

This matter of fuel-oil percentage has provoked much discussion. Actually, as little as 1% pilot oil will fire the gas charge but that must be considered impractical with a normal fuel system. Percentage of fuel oil affects performance very little at full load and the gas-diesel is not sensitive to percentage differences down to about 75% load, but the effect is definite at light loads. This is readily explained.

Gas-air ratio runs much leaner at light than at full load and it finally becomes so lean that it will not propagate flame at all. Therefore a condition is reached at extremely light loads where the only part of the gas burned is that which comes in contact with the actual fuel-oil flame. For this reason the gas-diesel, though inherently highly efficient at normal loads,

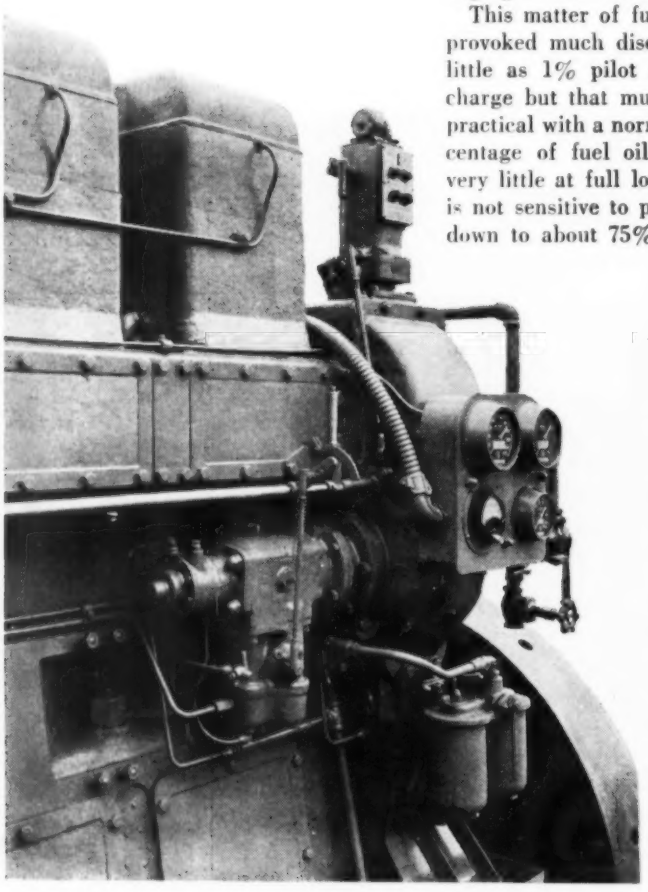


Fig. 13 (above)—Simplified form of control involves only addition of gas-regulating valve and linkage to governor; fuel-oil-control system remains unchanged. Mechanism of this control, and an adaptation of it, appears in Fig. 14, 15

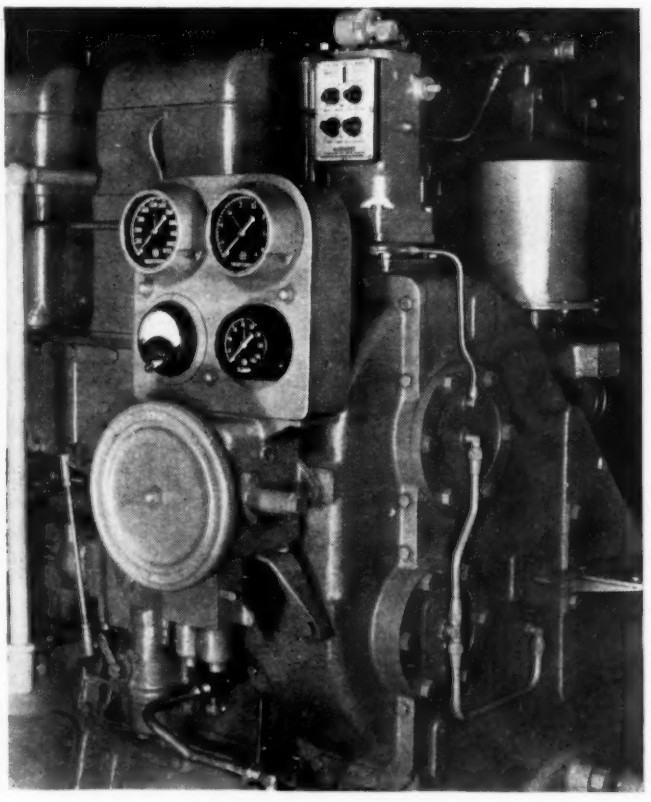


Fig. 12 (right)—Early control development led to system shown, with handwheel for shifting from one fuel to another

proves much less efficient than the oil-diesel at light loads, and may run even less efficiently than spark-ignition engines at very light loads.

It is this low-load portion of the curve that is sensitive to fuel-oil percentage. For example, consider the two curves of Fig. 11, run on Cooper-Bessemer 15½x22-in. atmospheric diesel: below about 55-bmep fuel-oil percentage is important, but above that point it has little effect on economy.

Fuel-Oil Percentage

For an engine operating mostly at full or nearly full load, a low fuel-oil percentage proves desirable from an economy standpoint—how low depends largely on the fuel-oil system. When we remember that it usually takes about 15% as much fuel oil to operate an engine when idle as at full load, it becomes apparent that speaking in terms of 5% the amount is scarcely enough to keep the engine firing. Allowing for fuel-oil system inaccuracies we consider it impracticable to think of using the normal fuel-oil system for much less than 10% fuel-oil delivery.

Fuel-oil percentages of less than about 10% can be obtained by using an auxiliary injection system for the pilot oil, with smaller nozzles and pumps. To avoid difficulties arising out of the fact that one or the other set of nozzles may be inoperative for long periods, we recommend use of the normal fuel system and toleration of a minimum of 10% fuel oil. This arrangement offers the further advantages of simplicity and lower gas consumption at light loads, where a higher fuel-oil percentage is preferable, Fig. 11.

Gas-Diesel Controls

When it came to controls for the gas-diesel, we started somewhat elaborately with a handwheel control, Fig. 12, which made possible a change from gas to oil, or vice versa, with one turn of the wheel. Returning to our basic philosophy of affecting the change from diesel to gas-diesel as simply as possible, we devised the control in Fig. 13 and 14.

To understand how this control operates, assume an engine to be operating on oil, but with the governor connected to both the fuel-oil system and the gas-supply valve. If the operator opens the gas valve, the governor moves to about mid-position and the engine operates temporarily on both fuels. If the operator moves the fuel-oil control to the minimum or pilot position, the engine becomes a straight gas-diesel.

Switching back to operation as an oil-diesel merely reverses the process. Releasing the fuel-oil lever to full position causes governor to take a midposition again and engine to operate temporarily on two fuels. Shutting off the gas valve throws the unit back to oil-diesel operation. Thus this system adds only a gas valve and link to the existing governor and leaves the fuel-oil system exactly as it was originally.

This simple control system meets almost all installation requirements but occasionally the gas supply is questionable and may fail, or partly fail, at any time, as in a sewage plant. In such cases, the operator wants an engine that operates as fully as possible on gas, automatically supplemented by oil as required. A simple adaptation of Fig. 14, shown in Fig. 15, makes this possible.

With this system, first half of governor travel is on gas while latter half is on oil. As long as gas is available to meet load the governor controls the engine by operating in the first half of its travel. If gas supply fails, the governor, attempting to keep the engine from dying, moves into the second half of its travel, thereby opening up the fuel oil. The engine continues without interruption. This system, and that of Fig. 14, offers the advantages of simplicity, freedom from need for adjustment, and low first cost.

The valve in the gas line, ahead of the governor control valve, Fig. 14 and 15, is a safety feature. It is controlled by (1) overspeed and (2) fuel-oil pressure. In this way gas is shut off in case pilot-oil injection should fail for any reason.

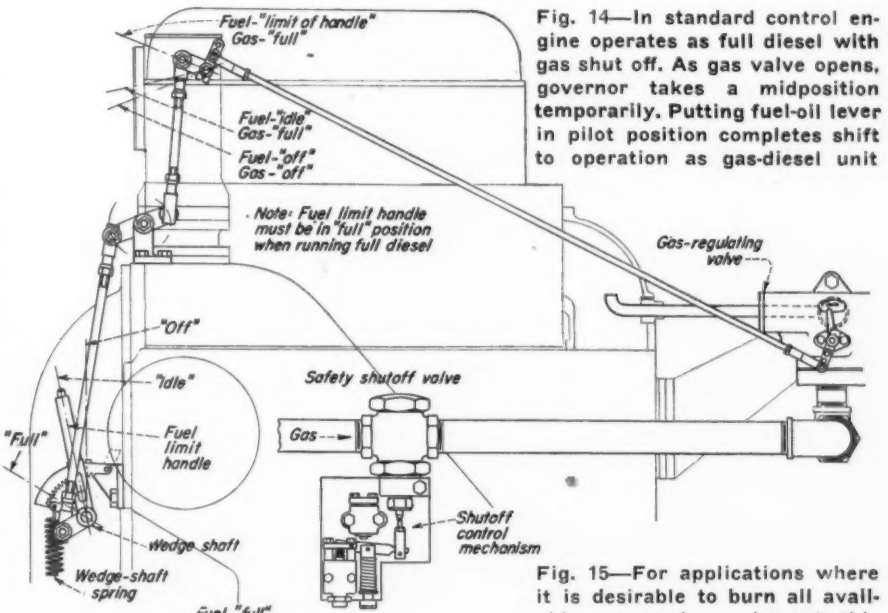


Fig. 14—In standard control engine operates as full diesel with gas shut off. As gas valve opens, governor takes a midposition temporarily. Putting fuel-oil lever in pilot position completes shift to operation as gas-diesel unit

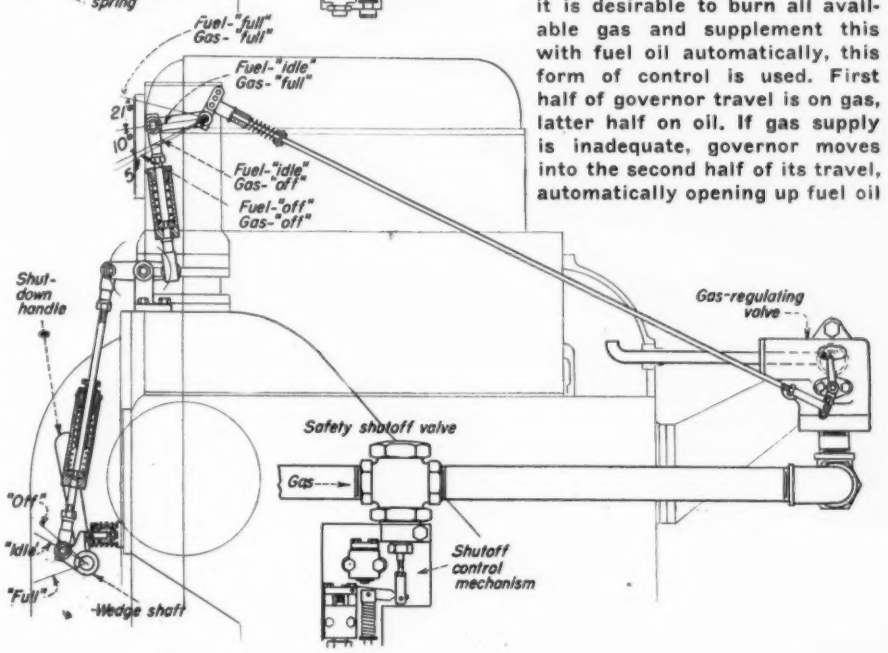
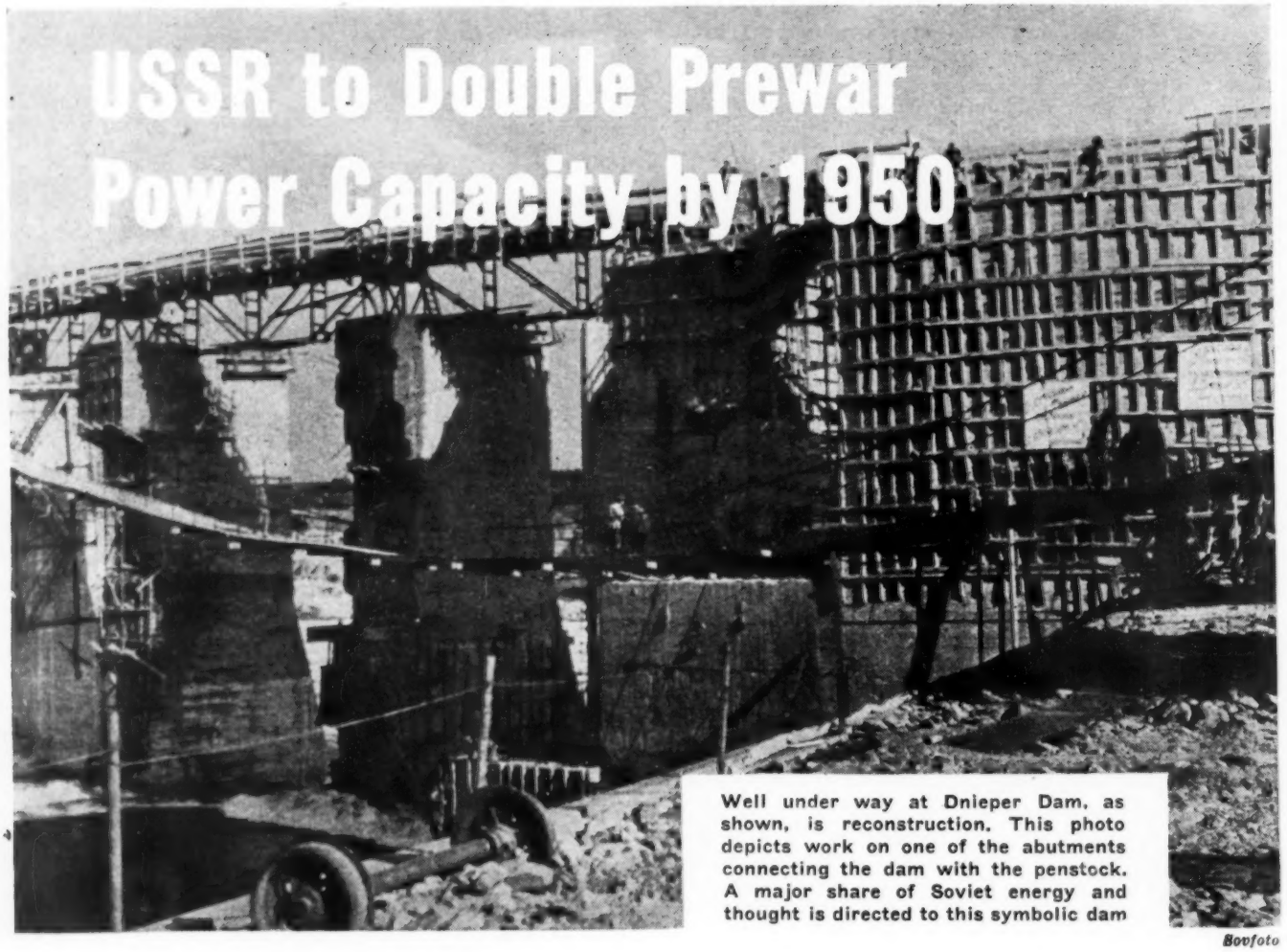


Fig. 15—For applications where it is desirable to burn all available gas and supplement this with fuel oil automatically, this form of control is used. First half of governor travel is on gas, latter half on oil. If gas supply is inadequate, governor moves into the second half of its travel, automatically opening up fuel oil

USSR to Double Prewar Power Capacity by 1950



Well under way at Dnieper Dam, as shown, is reconstruction. This photo depicts work on one of the abutments connecting the dam with the penstock. A major share of Soviet energy and thought is directed to this symbolic dam

Sovfoto

Surge of Soviet Russian industry strains her power capacity and equipment. Vast power projects of large hydro stations and many small thermo-electric developments serve a planned growth for industry and double the nation's electric energy

THE ALLIED CAUSE experienced one of its darkest days when the Germans announced the demolition of the great Soviet power site on the Dnieper River. But this staggering blow was but part of a wholesale reduction of Russia's generating capacity. Total losses now known reach 5,000,000 of an estimated 10,000,000-kw capacity at the start of the war in 1939. Of this reported loss, over 12,000 power station buildings were destroyed, and 14,000 steam boilers, 1400 turbines and 11,300 generators were evacuated to Germany. This does not include a temporary loss of 11,000 carloads of facilities also evacuated eastward.

Back in 1920 Lenin's first fifteen-year plan contained a program for 30 power stations with a total capacity of 1,750,000 kw. Actually in 1935 this goal had been achieved two and a half times with total installed capacity reaching 8,800,000 kw by 1938. The third five-year plan had set 17,200,000 kw for national power capacity by 1942 but war prevented its attainment.

Today Russia stands second to the U. S. in production and use of electric power. As soon as the tide of battle turned, she pressed reconstruction of power facilities so rapidly that 35 large stations have been rebuilt and all damaged or destroyed power facilities are expected to be replaced or repaired by the end of next year.

Generating equipment for the Dnieper works has been on order in the U. S. for over a year. Cumulative orders for power equipment in units of 2000-kw capacity, and under, exceed 1,356,000 kw. In addition, Soviet requests for 2,000,000 to 3,000,000 kw more of generating equipment have been discussed in Washington.

Rapid as this power reconstruction and expansion program is, resurgence of Russian industry is outpacing it. A campaign of criticism of this lag in domestic power output has appeared in Soviet newspapers indicating that delivery of U. S. generating equipment is even more urgently sought.

Principal criticism has been leveled at the Commissariats of Electric Industry and of Machine Building. The former department is charged with (1) failing to resume production of reactors and various protective devices and (2) not turning out sufficient power and voltage transformers, switching and releasing devices. The latter is accused of (1) not resuming production of turbine heaters and (2) not meeting the demand for steam and water fittings.

Further delays in Soviet conversion have been occasioned by an inadequate supply of turbine parts, cable and similar items, which can only be obtained otherwise through imports from the U. S.

In spite of these complaints and the magnitude of planned imports of U. S. generating equipment, it is well to realize that Soviet Russia now is able to produce all the types of necessary power-station machinery itself. With the exception of Dnieper's 90,000-kw units, Russia has produced most of the generators installed in its biggest power stations. A Leningrad plant completed during the war the first Soviet-built 100,000-kw francis turbine, with a 100-ton six-meter wheel. Before the war there were only three such wheels in Europe, one in Britain and two in the USSR.

Soviet production in the turbine field beyond smaller units includes 25,000-, 50,000- and 100,000-kw units; in boilers, 180,000-, 240,000- and 300,000-lb-per-hr capacities. With new developments scheduled for a 2,000,000-kw capacity increase each of the five years of this program for doubling power capacity, power investments will be far greater than formerly.

Industrial decentralization policy of the early thirties is still followed and emphasis on new power construction adheres to this theme. A long-standing intention of utilizing the tremendous hydraulic resources of the country and conserving coal, peat and oil resources well fits the decentralization policy.

War Accelerates Shift

In 1940 before Russia's entry in the war, some 30% of Soviet power stations were east of the Volga, concentrated in the Urals, and the Kuznetsk and Karaganda basins. Evacuation to these areas raised power capacity of Kuznetsk basin 50%, as well as others—Novosibirsk, Tashkent and Kazan, 100%; and Omsk, Kuibyshev, Karaganda and Krasnoyarsk, 200%. All told about 2,000,000-kw increase in capacity resulted from evacuation and new construction.

For the first time latest released maps of the USSR show the gigantic 1800-sq-mile lake which has been formed to furnish a steady flow of water to the spectacular hydroelectric development at the Rybinsk plant in the Great Volga system north of Moscow. In November 1941 Rybinsk's first 50,000-kw turbine went into operation, its second in January 1942, and its third in September 1945.

All developments are not restricted to hydro plants. Refinement and improvement of techniques with peat and low-grade coals have spurred interest in these fuels for smaller installations. Thousands of small rural plants are revolutionizing life on collective farms and hinterland communities. Goal set originally by the Commissariat of Agricultural Construction was 815 hydro- and 802 thermo-electric stations and sites for 2375 future plants. Realization fell short of this goal because of supply shortages previously mentioned.

Major hydroelectric power developments included in an all-out Soviet five-year power program are indicated by stars. Rybinsk station, north of Moscow, already in operation, requires an 1800-sq-mile lake, next to its star, for water supply

Railroad electrification continues apace with extensions of intercity high-tension lines in the areas of Moscow, the Donbas, Ukraine, Urals, Caucausus and farther east.

Soviet efforts to attain double power goals set in the current five-year plan are reflected in the emphasis placed on a critical role for electric power. A past indication of the regard held for this source of power is that 83.2% of all Soviet industrial processes were electrically operated before the war with such instances as machine-building, 95%; coal, 94%; chemicals, 93.3%; non-ferrous metallurgy, 98%.

One further interesting sidelight on Soviet efforts and determination to meet power goals comes from a situation that developed over a year ago on the Dnieper Dam project.

To restrain high spring waters from developing a washout during reconstruction of the penstock walls a barrier was considered necessary. Among several suggestions advanced a wooden structure needing an estimated 27,000 cubic yards of timber was considered. I I Kandalov, chief engineer, submitted plans that were adopted for a temporary dam of concrete rubble, stone and earth with a tarpaulin facing to prevent washing away.

While work progressed according to schedule, a general uneasiness persisted for fear that this temporary measure would not be ready in time. As a result collective farmers, high-school students, housewives, factory and office workers of the neighboring city of Zaporozhye volunteered for shovel or wheelbarrow detail.

By April 1945, this uneasiness was proved well founded for there were times when the water level reached within 16 to 20 in. of the still growing dam. That this rising water level never went over is a tribute to intensive and efficient work that always kept the dam a step ahead.

How Axial Thrust Is Balanced in Single-Stage Centrifugal Pumps

For reliable centrifugal-pump operation solve axial thrust problems. Alexander Brkich, engineer, Ingersoll-Rand, shows how the hydraulic forces acting on a single-stage impeller are normally unbalanced. He tells how to balance them, also what can happen during pump operation to increase the axial thrust

▶ ONE OF THE FIRST PROBLEMS that centrifugal pump manufacturers had to overcome was the hydraulic axial thrust that impellers develop. Of the various methods proposed, all have been eliminated that were too costly or did not stand the rugged test of service. The few basic methods that remain are segregated into fields of usage dictated by their inherent advantages and disadvantages. Understanding these methods and their limitations is desirable for successful operation and maintenance because to a great extent pump reliability depends on continuous counterbalance of its axial thrust.

To better appreciate the problems in getting an impeller in axial balance and keeping it there, first determine what is to be balanced. For this purpose, examine what happens around an ordinary single-suction impeller with the shaft running through its eye, Fig. 1. By rotation the impeller develops a higher pressure at its periphery than at its eye. At the same time, the impeller tends to rotate the liquid between its shrouds and casing. Because of the stationary casing wall, this liquid rotates at an average speed equal to about one half that of the impeller, which distorts the pressure distribution along the shrouds.

Pressure distribution on opposite sides of the impeller is indicated by the difference in length of the horizontal arrows. Pressure is highest at the periphery, as indicated by the longest arrow, and decreases toward the eye and hub, where the arrows are shortest. On the front or left-hand shroud, pressure resulting from the discharge is distributed between the eye's outer diameter D and the discharge diameter D_1. On the back shroud, pressure resulting from discharge is distributed over its entire area, between the shaft diameter D_2 and the impeller's outside diameter D_1.

Pressure over area F, between the eye's outer diameter and discharge diameter D_1, is balanced by pressure over an equal area, B, on the impeller's back. This leaves pressure over area C at the impeller's back to act against suction pressure over an equal area at its suction eye. Suction pressure may be most any value from below atmosphere up, but is always less than that acting on the impeller's back; consequently there is always a thrust toward the suction of a single-suction impeller.

In Fig. 1 the shaft runs through the eye, so the impeller is supported by a bearing, front and back, and has two stuffing boxes to seal the shaft where it comes through the casing, as in Fig. 3. In many pumps the impeller is overhung

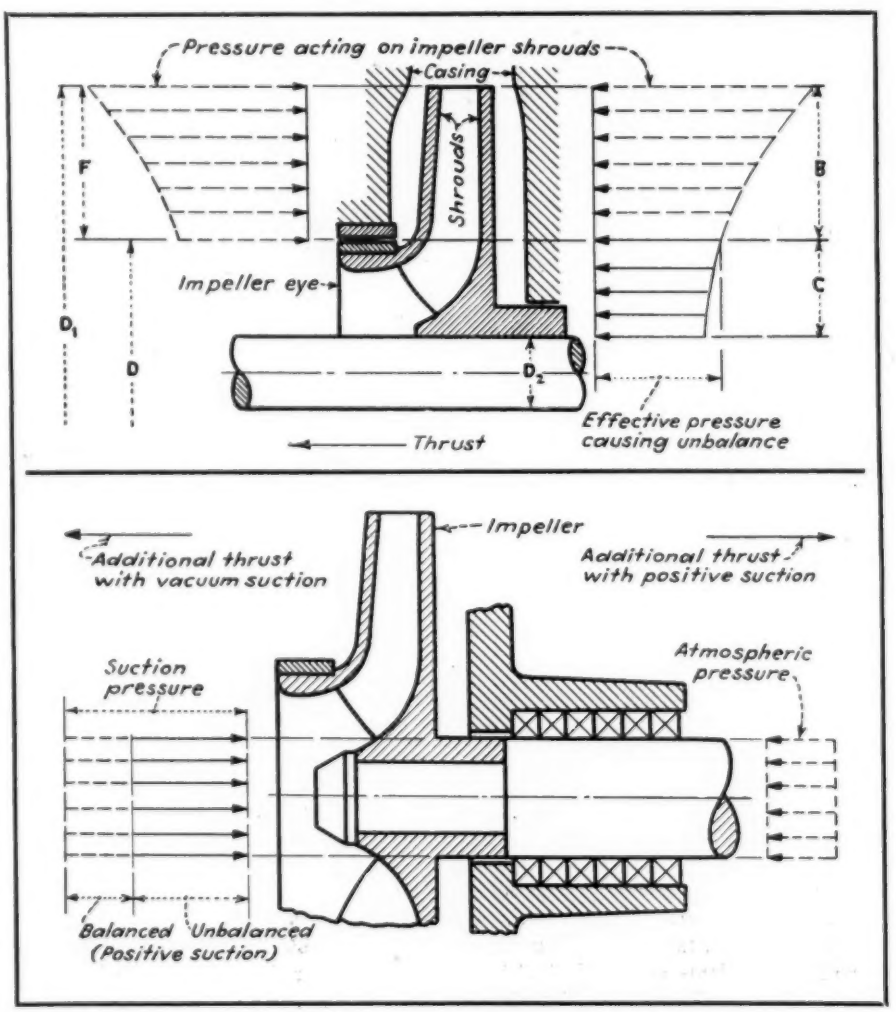


Fig. 1 (above)—Unbalanced pressure acting over an area equal to that of impeller's eye causes hydraulic axial thrust on single-suction impeller. Fig. 2 (below)—With an overhung impeller an additional unbalanced force is caused by suction pressure acting on one end of the shaft and atmospheric pressure on the other

and requires only one stuffing box on its shaft, Fig. 2. In these pumps there is an additional thrust related to the product of the shaft's area projecting through the stuffing box and the suction pressure. The reason is that, outside the pump there is only atmospheric pressure on the shaft's end, while inside the casing, suction pressure acts on the same area. Therefore, if the suction eye is under vacuum, there is an additional thrust toward it, and with a positive suction, this thrust is away from the suction because of pressure on the shaft's cross-section.

In practice, only positive suctions are important because vacuums are limited to a net pressure difference of 14.7 psi. whereas positive suctions can have any value. Assuming a 3-in. shaft, full vacuum would result in a pressure difference of only 104 lb, but a positive suction of 100 psig would produce 710-lb pressure difference.

One way to eliminate thrust is to use two impellers, mounted back to back. In effect, that is what a double-suction impeller is: two impellers are cast as an integral unit, Fig. 3. Liquid entering the pump divides and flows into the impeller from opposite ends. Under ideal conditions the hydraulic axial forces acting on one side of the impeller balance those on the other, and there is no thrust. In actual operation, however, it may develop, as when either side of the suction becomes partly obstructed. Flow is then no longer equally distributed between the sides of the impeller, and the hydraulic axial forces become unbalanced. This would also be true if the casing were not symmetrical on both sides of the impeller. A horizontal elbow at the suction will cause unsymmetrical flow. In large pumps, impeller-eye areas are so large that one or two pounds' difference in the suction pressures on the two sides can easily produce a thrust of 400 lb. For these reasons, double-suction pumps require thrust bearings of ample size.

A double-suction impeller is inherently stable at all capacities, only requirement being that flow remain evenly divided between its two sides. Wear has little effect in throwing the hydraulic axial forces out of balance as long as both sets of wearing-ring clearances wear uniformly. If they do not wear alike, more leakage flows through one than the other to cause an unbalance of the hydraulic axial forces. Pressure will be lowest on the shroud adjacent to the greatest leakage with a consequent thrust in that direction.

Even though double-suction impellers are applicable for a wide range of services, there are fields in which they would impair the pump's hydraulics or its usefulness, for example, in low-capacity high-head applications where a single-suction impeller is the preferable one to use.

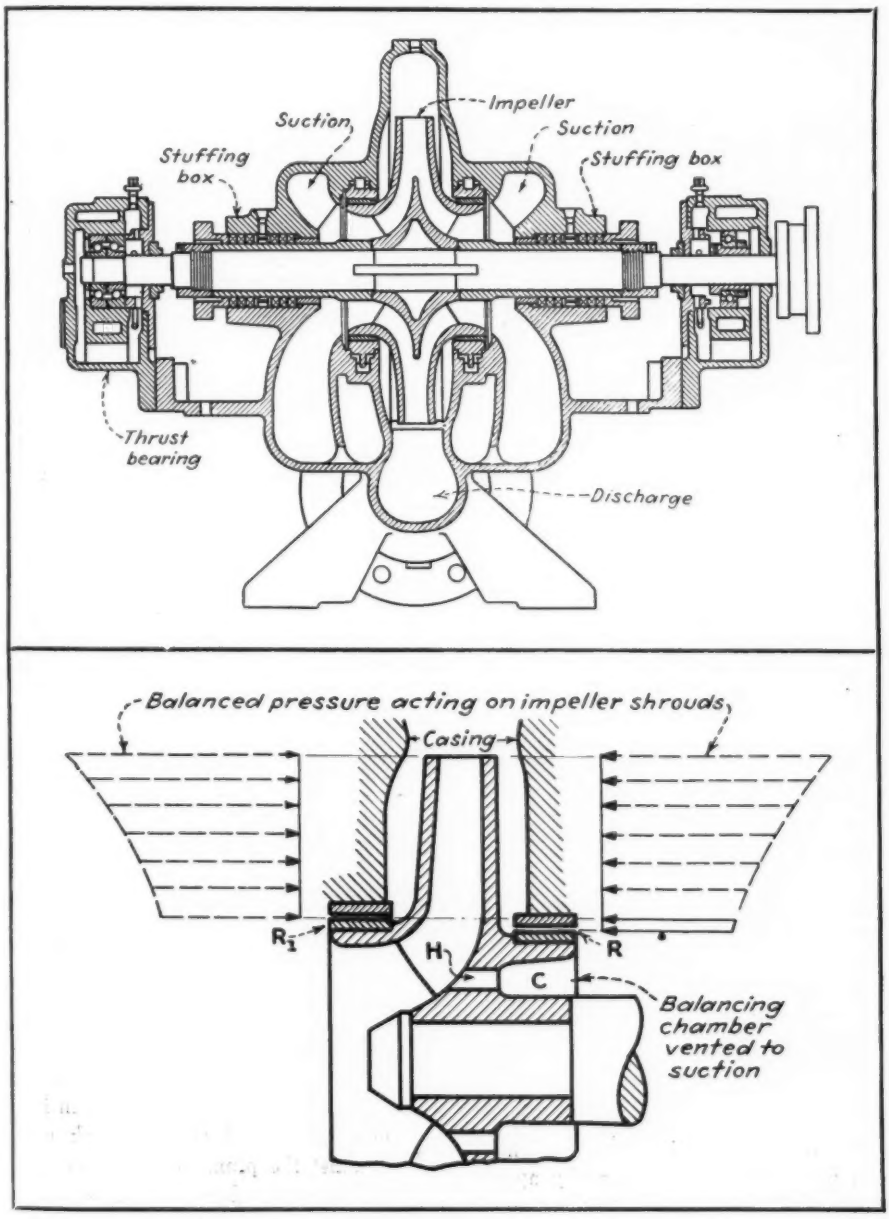


Fig. 3 (above)—In double-suction impeller, hydraulic forces are theoretically in balance, but in practice they generally are not, requiring a thrust bearing. Fig. 4 (below)—To obtain complete hydraulic axial balance with an overhung impeller, the suction pressure should determine its back-wearing-ring diameter

Thrust Balancing

One method of balancing the hydraulic axial forces on a single-suction impeller uses wearing rings R on the back shroud and connects the inclosed chamber C inside the ring by holes H to suction pressure, as in Fig. 4. Essentially, this method is identical to one that uses a double-suction impeller with one side blocked off. But since flow is on one side only, complete hydraulic balance is never fully attained for the pump's entire capacity range, even though chamber C is vented directly to the impeller's eye.

The back ring's diameter determines the amount and direction of the residual thrust. If the shaft runs through the eye, then back rings R have about the same diameter as front rings R_1. If the impeller is overhung take into account suction pressure also because a positive suction may develop an appreciable thrust toward the back shroud. To balance the thrust under these conditions the diameter of rings R are reduced by an amount necessary to compensate for the thrust due to suction pressure on the shaft's end.

This method works satisfactorily with

overhung impellers. However, a given-size back ring *R* is suitable for a limited range of suction pressures only, determined by the thrust-bearing load limits. With small pumps, because of their shaft size, a considerable variation in suction pressure can be tolerated before axial thrust becomes objectionable.

Main disadvantage of the axial-thrust-balancing method, Fig. 4, is maintenance of an extra set of wearing rings. Since conditions around the rings on the impeller's back are about the same as at the eye rings, the leakage reduces the pump's efficiency. Wear on the rings increases the leakage through them and tends to reduce the pressure on the outside of the shrouds. If this wear is uniform on both sets of rings, the originally balanced areas will still be balanced since the pressure drop will affect both alike. Since leakage through back ring has increased, pressure may build up in the balancing chamber and create a thrust toward the suction, particularly if the chamber is not vented sufficiently. As a result, the final effect of wear is dependent on the actual impeller used.

With smaller pumps, complete balance at all capacities is not necessary because of the smaller thrust load. A suitable ball bearing can easily handle any residual axial force that exists. Radial ribs on the back shroud, Fig. 5, provide a satisfactory method for handling these conditions. This method is used with overhung impellers almost exclusively. With this simple arrangement, pressure at the back shroud is reduced considerably because liquid in the clearance must rotate at impeller speed. Pressure reduction on the back shroud is indicated by the shortened arrows.

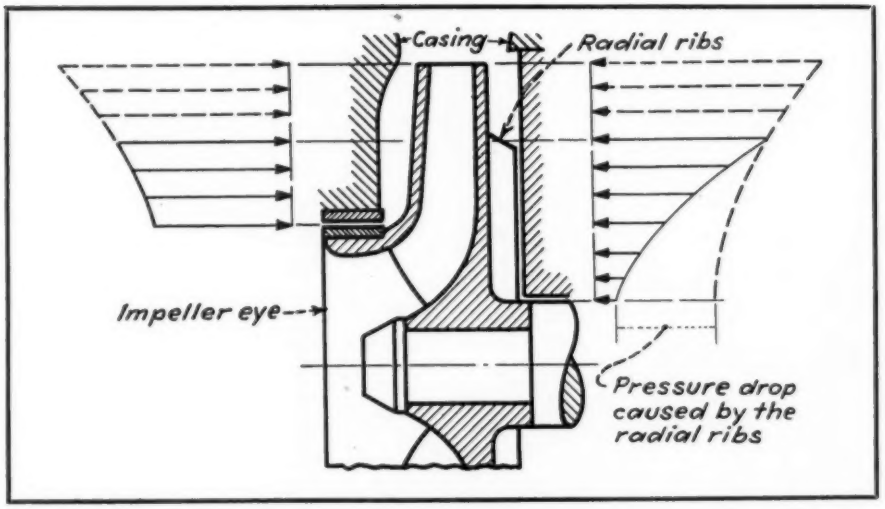


Fig. 5—Hydraulic axial balance of single-suction impellers can be obtained by radial ribs or vanes on the back shroud that reduce the pressure in this area

As with back wearing rings, radial-rib length to give axial balance at any given capacity depends on suction pressure. Balancing the impeller's axial thrust at only one point on the head-capacity curve is satisfactory. When the pump is operated near shutoff, axial thrust is toward the suction; at high capacities, the thrust is reversed. In practice, however, an average rib length suffices for a wide range of conditions. The limitation, of course, is the thrust capacity of the bearings.

Simplicity is the chief advantage of ribs on the back shroud for balancing axial thrust. There are no parts to wear since clearance between ribs and casing can be as much as $\frac{3}{32}$ in. Wear at the front wearing rings relieves pressure along the adjacent shroud, but ordinarily, the effect is negligible in the smaller-sized pumps. When wear has reached an advanced stage where it causes serious unbalance, efficiency demands renewal of the rings.

On small pumps and lower heads than those that require radial ribs on the impeller to balance axial thrust, suitably designed thrust bearings can handle the full thrust load. There are a variety of types to choose from, but deep-groove and angular-contact ball bearings are the most popular. Since the pump has no special thrust-reducing parts to wear, nothing has to be maintained because of thrust elimination. With proper care, the bearings should serve their expected life.

On vertical turbine pumps the motors are especially designed to carry full thrust without any assistance from within the pump. Innumerable installations of the kind have run for years without thrust-bearing trouble.

The Thumping Waterwheel Generator

By N L REA
Service engrg div, General Electric

► RECENTLY the maintenance engineer of one of the power companies came in for advice. One of his vertical waterwheel generators had started vibrating and developed a distinct thump every revolution.

On removing the field they had found journals and bearings in good condition but there was a scored spot on the shaft above the lower guide bearing, about ½ in. wide, several mils deep, extending about 90 deg around. A vapor guard above the lower bracket was broomed over from its original thickness of ¼ in. to about ½ in. Neither shaft nor guard showed color from having been heated.

"I'm afraid you have a bent shaft caused by rubbing," I told him, "and I suspect the rubbing was caused by some unbalance, which caused the shaft to skate on the thrust bearing and ride the journals, with the heavy side always against them."

"Hmm," he said, "what do we do?"

"As there are no apparent changes in the unit's revolving parts, I recommend the following procedure: First check field coils for short-circuited turns by applying 220-v 60-cycle current to a group of coils so that you get about 30-v drop across individual coils. You'll find that end coils of a group read lower than those in the middle, but by progressing, say half the group, you can get a test in all coils. Ac gives a better test than dc, because any shorted turns in a coil make it a transformer and the shorted turns buck down the impedance of the whole coil.

"Second, set your rotor approximately plumb, install a wood cross at the shaft top and mount four steel plumb lines, 90 deg apart. Put heavy weights, 20 lb or more, on the lines and swing them in buckets of heavy oil. Connect several dry cells to the wires and the shaft, with head phones in the circuit. Mount an inside mike in a V-block and check the shaft against the plumb lines at several points above and below the field, adjusting the mike until the phones just click when the pin passes the wire."

Later the engineer wrote me. The field

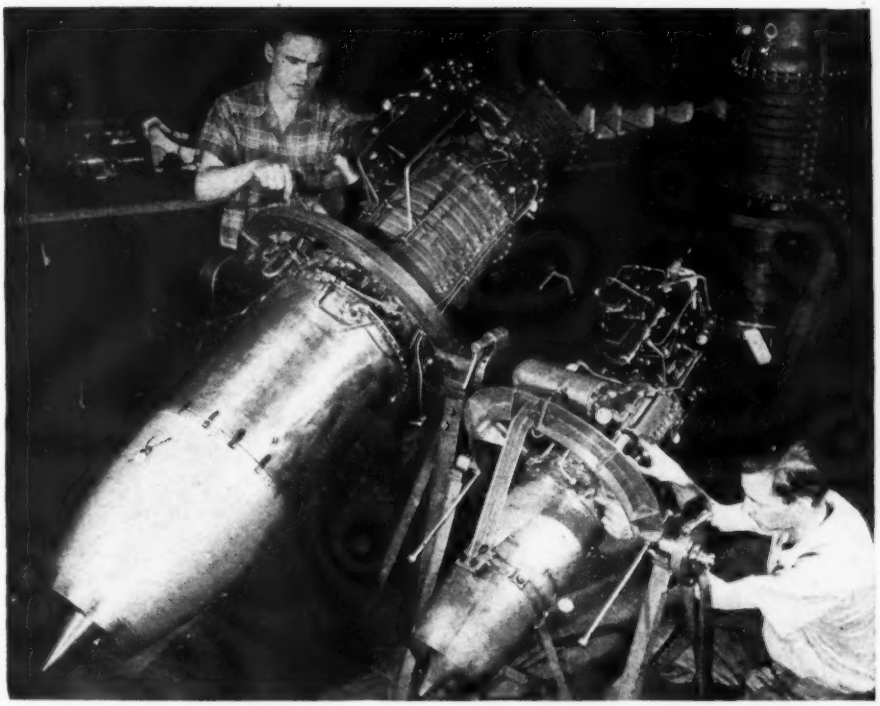
(*Continued on page* 146)

Axial-Flow Design Makes Possible Light, Compact Aircraft Gas Turbines

► RAPID PROGRESS in aircraft gas turbines for jet propulsion and propeller drive has confounded the skeptics who put plane applications at the bottom of the list for the new prime mover, well behind locomotive, marine and stationary fields. Intensive wartime development has given us practical power plants for fast military craft and promises still larger and more efficient units for high-speed transports.

Typical of recent aircraft gas-turbine developments are the jet units designed by Westinghouse Electric Corp for the Navy, details of which have just been announced. Specifically charged with designing a completely new unit, Westinghouse engineers built the power plants around the axial-flow compressor. This permitted straight-through air flow (see diagram below) and resulted in extremely compact and light-weight units.

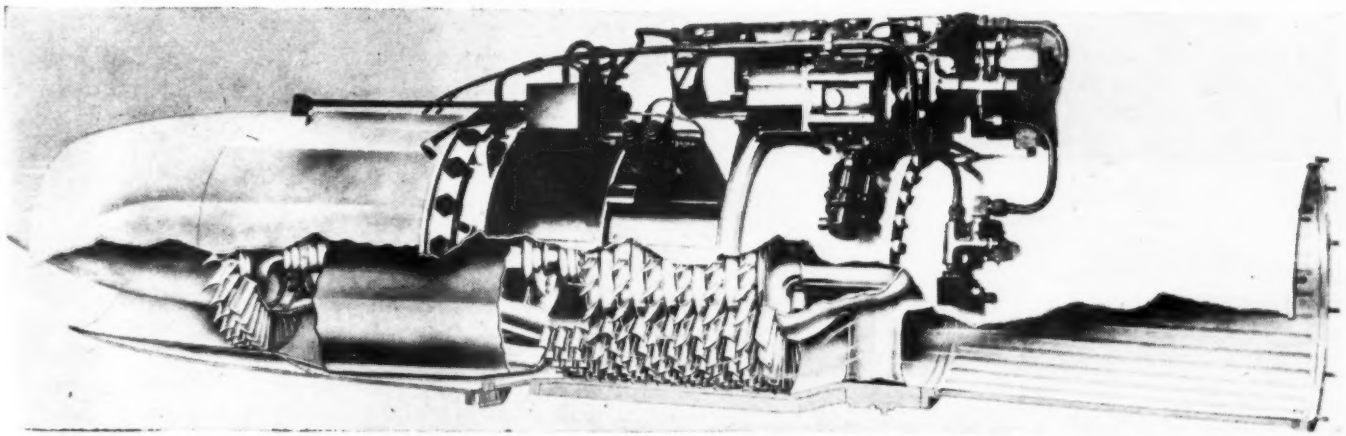
Of two engines shown, the larger is 19 in. in diameter, runs at 18,000 rpm and weighs about 500 lb, less than half as much as a piston engine of the same output. Air—50 tons per hour of it—flows through a nose section directly into the axial flow compressor which delivers it at higher pressure to an extremely simple open combustion chamber immediately behind the compressor. Fuel, sprayed through a number of atomizing nozzles, burns at extremely high combustion rates, about 1000 times as high as in conventional stationary boilers. Air particles spend about 1/100th second in the combustion chamber. Combustion products, at about 1500 F, enter the single-stage turbine, which produces about 3500 hp to drive the compressor and provide the jet thrust. At modern plane speeds thrust is about 1400 hp.



Jet unit at left is 19 in. in diameter and, at modern plane speeds, produces a thrust equivalent to 1400 hp. Smaller unit, 9.5 in. in diameter, has thrust of about 275 hp

The smaller of the two engines shown, developed for a "buzzless" bomb or guided missile, is 9.5 in. in diameter and, at 34,000 rpm, it produces thrust of about 275 hp and weighs less than 150 lb.

In showing these Navy units, Westinghouse announced that its program for development and production of aircraft gas turbines will be expanded to match the expected future prospects for this type of power plant. Nearing completion is a $10,000,000 production plant.



Cutaway view shows straight-through air flow resulting from use of axial compressor. From right to left, components are: (1) throat or air scoop (2) axial compressor (3) combustion chamber (4) turbine and (5) jet nozzle. Accessories, grouped at top of unit, are driven by right-angle gearing from the compressor shaft. Compact design reduces air resistance

Long Island

While the new boiler installation meets immediate load increases, a new plant is being considered for future needs. Condensation of talk before steam power division, ASME, October 17, by W Welch Jr, steam power engineer of the Long Island Lighting Co.

Fig. 1—Glenwood No. 2 station of the Long Island Lighting Co located at Glenwood Landing, Long Island, has 170,000-kw turbine-generator capacity installed

► THE LONG ISLAND LIGHTING CO SYSTEM serves nearly all of Long Island east of New York City and the Rockaway area within the city limits. This territory comprises residential, farming, resort and industrial areas. In the westerly section adjacent to New York City there is a comparatively well built-up area of suburban communities. In recent years a large aviation industry has been established in the vicinity of Farmingdale.

Before 1941 demands consisted mainly of residential load plus commercial, transportation and other service loads typical of this kind of territory. Being predominantly lighting, the load was characterized by high peaks and low generations and, therefore low load factors. There were two seasonal peaks, one in summer caused by heavy demand in the resort area and one at the Christmas season from holiday illumination. Load growth has increased sevenfold in the last 20 years because of territory development, improved living standards and company sales promotion activity.

Since 1942 the industrial load has grown at an accelerated pace largely caused by aviation and associated war industries. During the war the industrial load practically doubled and was about 35% of the total at the war's end. Generation increased more rapidly than peak demand resulting in higher load factors.

Fig. 2 shows monthly variation in generation, peak load and load factor for the past five years. Note the improvement in load factor in 1942 and effects of wartime and blackout regulations on the system peak load during the winter of 1942-1943.

End of the war caused some cut-back and cancellation of war production in this territory. In October 1945 generation was running about 5% lower than in the corresponding 1944 period and the peak demand had increased about 5% because of return to Standard time. Fig. 3 shows both a comparison of weekly generations for the past several years and the present trend. Studies indicate that the future load will resume the characteristics of a predominantly residential territory with high peaks and low load factors.

To meet immediate load growth a new boiler is under construction at the Glenwood station. For future needs the first unit of a proposed new plant is now being considered.

At Glenwood the new boiler will have a steam-generating capacity of 400,000 lb per hr; in effect it completes the plant development. Boiler size was predicated upon filling deficiency in steam-generating capacity and upon providing needed boiler reserve against planned and emergency outage of existing boilers. It will be operated mostly at 300,000 lb per hr, having been designed for peak efficiency at that rating. Capacity operation is expected to occur only for peak loads and emergencies.

Based on present load estimates the new boiler should operate at good capacity factors for some five or ten years after which it may be relegated to swinging loads and peak-load service as more efficient generating units are placed on the system. In view of these expectations a wide range of operation from 80,000 to above 400,000 lb per hr has been specified as well as a flat superheat characteristic.

Liberal Design Basis

Design has been liberal throughout to avoid operating and maintenance problems encountered in recent years with older boilers. Possible future use of lower-grade coal has also been provided for in the design.

Boiler design is restricted because of its installation in a plant that was started in the late 1920's, and enlarged several times. Pressure and temperature will be that of the present station, 400 psig and 750 F. The boiler is being built in a space originally intended for a smaller unit of different design; hence some crowding of auxiliaries could not be avoided. To allow maximum utilization of existing

Lighting Completes Glenwood Station

equipment the present bin-storage system will be applied to the new unit. Provision is being made for possible future extension of the station fuel-oil system to this boiler.

Fig. 4 shows a cross-section of the Combustion Engineering boiler of bent-tube 3-drum type designed for either pulverized-bituminous-coal or fuel-oil firing. The furnace is liberally designed for burning Eastern low-volatile bituminous coal having 18.4% volatile matter, 6.6% ash, 14,367-Btu-per-lb heating value and an ash-softening temperature of 2500 F. As a precaution against possible future use of lower-grade fuels furnace design was based on burning coal of 25 to 28% volatile matter with ash-softening temperature of 2200 F. Coal for this boiler will be limited to what the older boilers can burn since all operate from the same bin-storage system. With a wider range of fuel capability built into this unit the operating and maintenance problems encountered with the older boilers in recent years should be avoided.

The dry-bottom furnace is designed for heat release of 20,000 Btu per cu ft per hr at 400,000 lb per hr steam generation. Every effort is being made to eliminate slagging of the furnace, which is practically 100% watercooled. Many wall blowers are being installed in the upper furnace walls. Spacings of screen tubes, superheater tubes and first boiler tubes are all wider than customary for this pressure-temperature range.

Superheater is of the pendant type. Superheat control is effected by a combination of tilting burners and bypass damper. An economizer is not included.

Pulverized coal is stored in the 200-ton bunker from which it flows to six coal feeders and then to twelve burners distributed equally at the four furnace corners.

All fans, air heaters and dust collectors are being installed in duplicate so that the loss of any one auxiliary will reduce boiler output to only about 250,000 lb per hr. Auxiliaries are arranged in parallel flow lines without any cross-connections.

The American Blower Co is furnishing forced-draft, induced-draft and primary-air fans. Induced-draft fans will be driven by 2-speed motors and have inlet-louver control. Forced-draft and primary-air fans will have single-speed motor drive with inlet-vane control on the former. Boiler auxiliary-drive motors are being protected by interlocks, experience having proved this arrangement worth while from a number of viewpoints.

Western Precipitator Corp's multiple cyclone dust collectors are being installed as experience with both electrostatic and mechanical precipitators has shown the latter satisfactory.

The Vulcan Soot Blower Co is furnishing a completely automatic-sequential compressed-air-operated soot-blower system for the boiler, superheater and furnace waterwalls. Wall-blower, mass-blower and retractable units will be included. Compressed air, used for soot blowing on the present boilers is being extended to the new boiler. These elements will operate at 250 psi. The air-preheater soot-blower system will also be compressed-air operated and connected into the boiler system.

Refractory & Insulation Corp's rock-wool-batt insulation, which has been successful in the past, will be used on ducts and equipment.

The Hagan Corp will furnish a complete automatic-combustion-control system, including a master control and instrument board. Feedwater control will be the Bailey 3-element type.

Ash and dust from the ash hopper and dust collectors and other points will be removed by a United Conveyor vacuum-pneumatic system. A complete new ash-and-dust-removal system, including tile silo, steam and mechanical vacuum pumps, dust separators and dust unloaders, will have adequate capacity to handle also ash and dust from an existing 550,000-lb-per-hr boiler. This will reduce the overload on the present inadequate ash sluice pit which will serve only for small boilers.

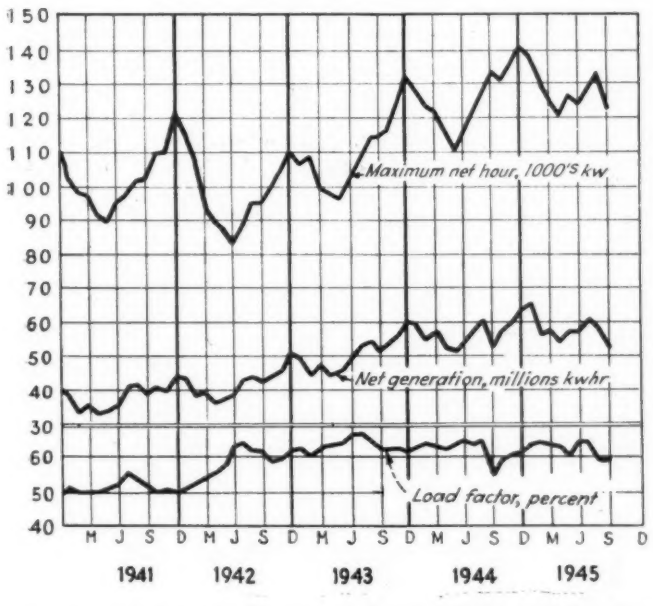


Fig. 2—Monthly outputs and maximum demands of the Long Island Lighting system increased markedly during the war period with an accompanying improvement in the load factor

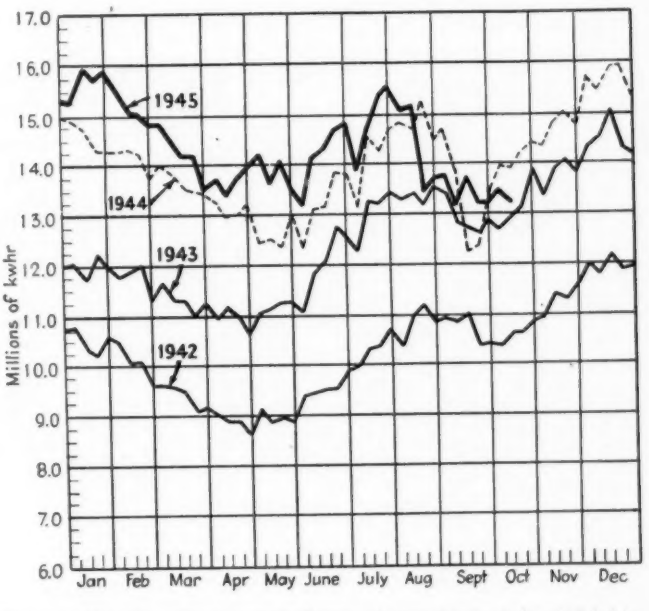


Fig. 3—Weekly gross generations of the Long Island Lighting system, 1942 to 1945. Secondary maximums during hot weather are caused by addition of summer-resort loads

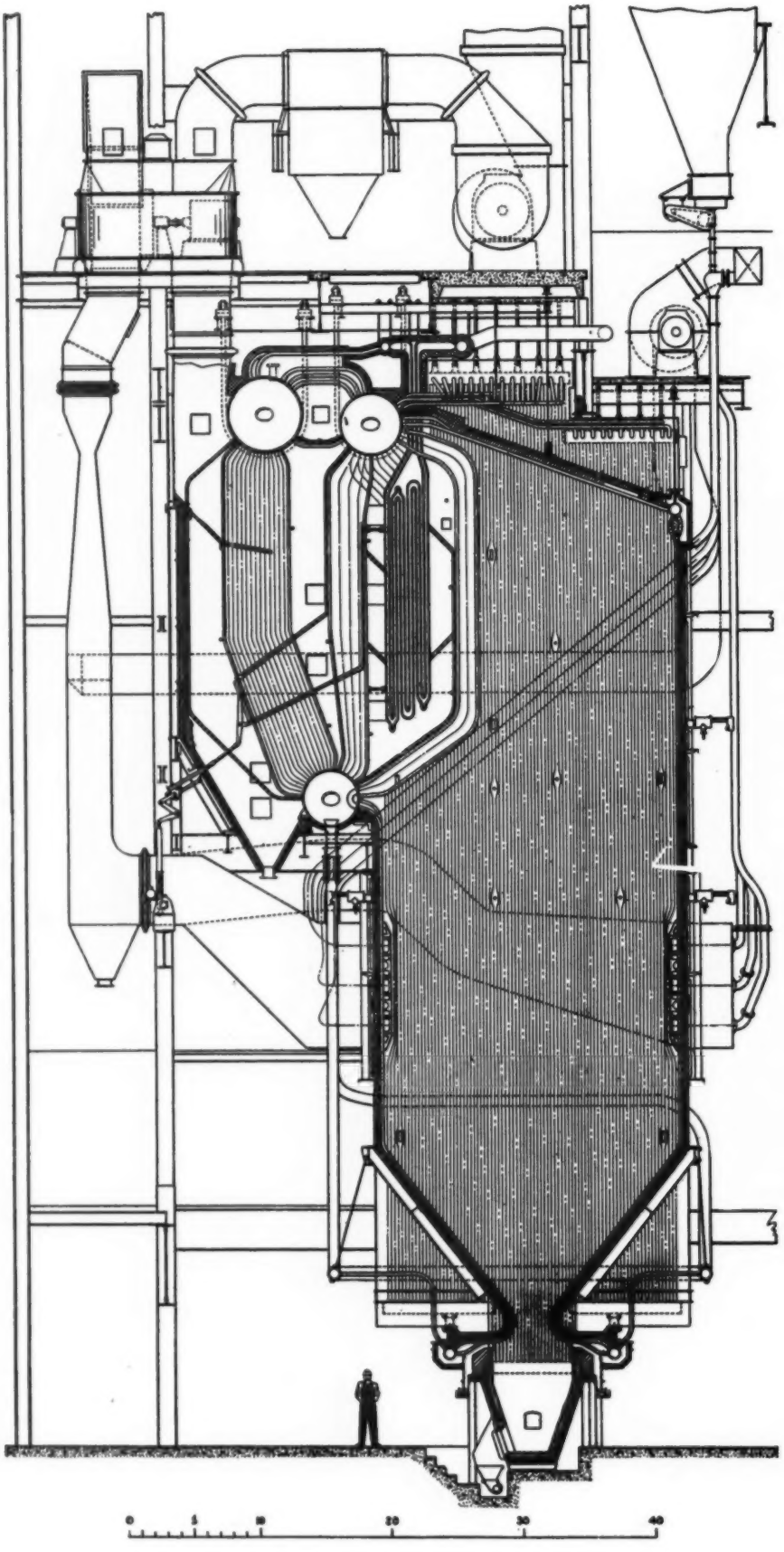


Fig. 4—Under construction in Glenwood station, Combustion Engineering bent-tube 3-drum tangentially-fired steam generator is rated at 400,000 lb per hr steam output, 400 psig, 750 F, 20,000 Btu per cu ft per hr furnace heat release. Steam superheat is controlled with combination of tilting burners and bypass damper

The present bin-storage system of firing will make possible the wide operating range contemplated. No additional pulverizing equipment is to be installed as present mill and fuel-oil-burning capacity are adequate for full station output. A new 200-ton pulverized-coal-storage bin is being built together with an extension to the existing transport system. Coal from the bin is measured by six duplex Combustion feeders to supply the twelve burners arranged in three levels of four burners each for tangential firing. Burners are designed for flame position control by adjustable air vanes and burner tips.

Coal-Feeder Drives

Drives for the coal feeders received a considerable amount of attention and the final arrangement appears quite attractive. It has been the custom to drive pulverized-coal feeders with rheostat-controlled shunt-wound dc motors. This system does not always give smooth speed control nor does it especially achieve exact parallel operation of several feeders. Further, the cost of such an arrangement is high when duplicate motor-generators are required for direct current. Other variable-speed-drive units such as magnetic-couplings and belt-drives have not been entirely successful in some installations.

The device selected, Westinghouse 3-hp ac adjustable-speed drive, seems to overcome all objections. The units are used in some quantity for machine-tool drives and consist of a motor-generator set with series-wound generator supplying a series-wound dc-drive motor. The generator series-field circuit includes a rheostat for control. One such unit of 3-hp size will be furnished for each duplex feeder.

Fig. 5 shows how this unit has been adapted to coal-feeder drives and automatic-combustion control. Burners are arranged in three levels of four each. As each duplex feeder supplies two burners, there are two feeders per level of burners, or six feeders in all. The series-field rheostats of the drive units for the two feeders of the same level of burners will be ganged together and operated by a single combustion-control regulator. These three regulators will be responsive to the same master loading source and will proportion coal feed as required by steam demand.

A hand-sender relay on the control board for each of the three feeder regulators permits independent operation or burner load biasing on each level. Only the drive motors will be located at the feeders and they will be totally inclosed to reduce commutator wear from coal

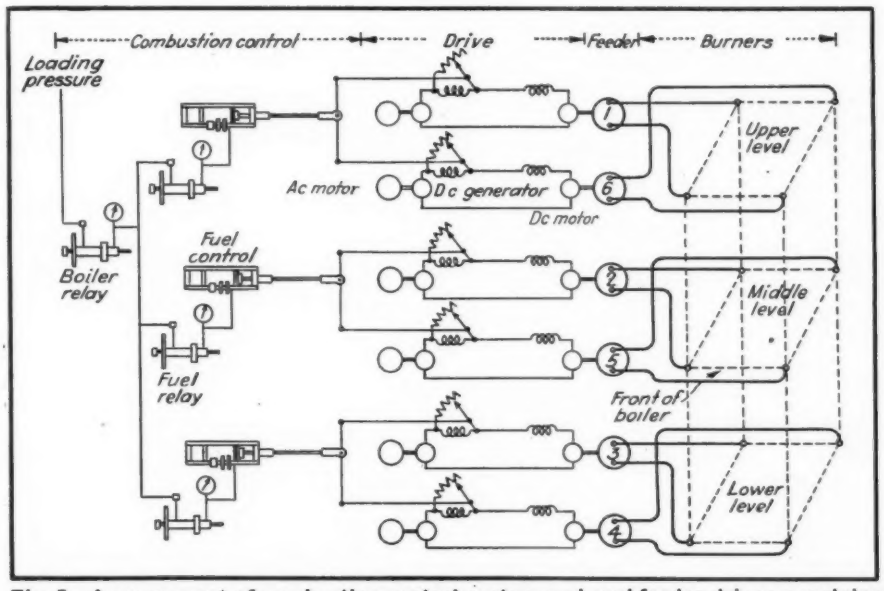


Fig. 5—Arrangement of combustion-control system and coal-feeder drives supplying the twelve tangentially arranged burners of the new boiler at Glenwood station

dust. The motor-generator sets and control equipment will be located in a ventilated cubicle adjacent to the feeders.

In controlling superheat the bypass damper will provide the primary control and be regulated by a Leeds & Northrup steam temperature controller. Superheat can also be regulated by flame position in the furnace; directing the flame upward increases temperature and a downward direction lowers it. As the burner-tilting mechanism is also operated by L&N equipment, interlocks have been provided between the two systems. Operation of the bypass damper will be confined to a moderate range and extreme temperature conditions will be corrected by positioning the burners.

The combustion-control system is similar to an arrangement developed by Hagan several years ago for an existing 550,000-lb-per-hr boiler. Coal-feeder speed and primary air flow are directly responsive to the master loading. Forced-draft air flow is maintained by the steam-flow air-flow differential through compensating relays to give correct combustion conditions. Fuel correction is made first and air correction follows. Induced-draft fans are controlled through the furnace-draft regulator.

To meet the increasing load beyond the immediate future the first 40,000-kw unit of a new unit plant is being considered. The proposed plant is visualized as simple, compact and easily operated with complete instrumentation and automatic control. There will be one boiler per turbine with all auxiliaries in duplicate. As fuel cost at this plant will be relatively high, fuel efficiency is important. The turbine would most likely be straight condensing, without reheat, operating at 1250 psig and 950 F with five points of extraction for feedwater heating. The generator would be hydrogen cooled. With an expected heat rate of about 10,730 Btu per kwhr this unit would be the most efficient on the system and carry base load.

The design would be strictly on the unit scheme so previous construction would not restrict following installations. Such facilities as coal handling and storage, ash disposal, fuel-oil equipment, docks and circulating-water systems would be designed for expansion to the ultimate plant.

The new station would be located on a waterway to allow fuel delivery by barge. As the harbors of Long Island are subject to winter freeze-ups adequate fuel-storage facilities would be provided. Pulverized coal would likely be the primary fuel although oil is contemplated as a supplementary fuel. The boiler would be designed to burn the lower fuel grades expected in the future as well as the fuels presently available. Much thought will be given to the avoidance of recent difficulties in handling and burning of wet storage coals.

USSR Tashkent Plant Uses Solar Energy

► FIRST INDUSTRIAL UTILIZATION of solar energy will make an appearance shortly when a new type solar converter begins supplying power to the Tashkent Cannery at Tashkent, Uzbek in the USSR.

Finishing touches are now being given to two experimental industrial converters of solar energy designed by the solar energy group of the Power Institute of the USSR Academy of Sciences. Dr Federico Molero heads the group. Methods have been worked out for producing huge paraboloidal mirrors capable of achieving high concentrations of solar energy with installations not requiring any great degree of precision to manufacture. These units can produce steam at all temperatures and pressures required in industry.

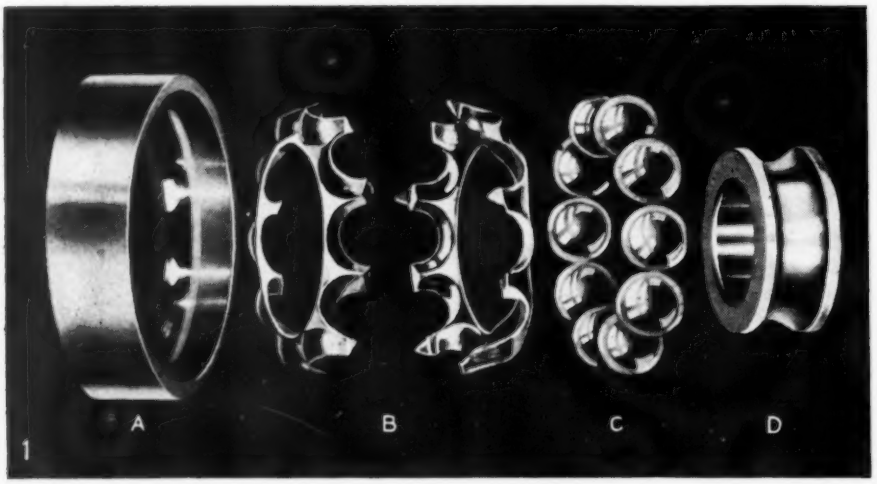
In some branches of Central Asian economy the highest power requirements coincide with the sunny season of the year. This is true of agriculture where solar installations can pump water for irrigation systems, watering livestock, and refrigeration. Ice that can be produced with solar energy is needed most of all in the seasons that have a maximum of sunshine.

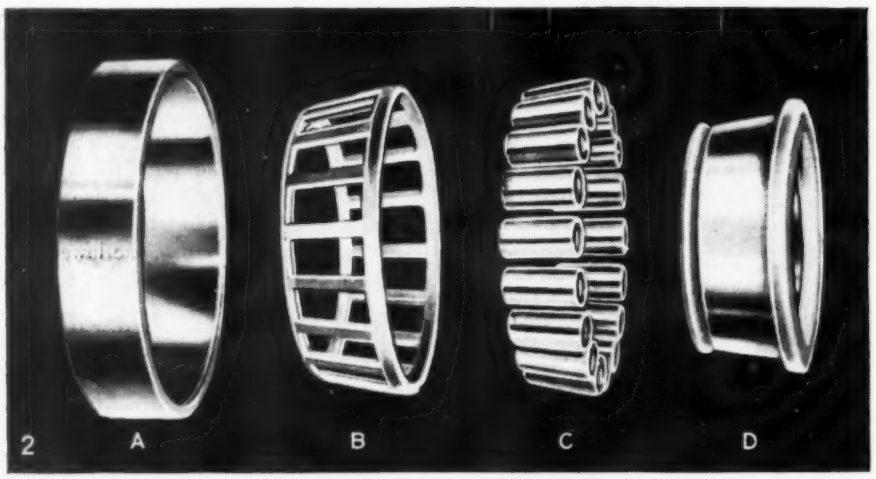
Sun installations that work parallel with ordinary steam equipment will also find extensive use at factories producing vegetable oils. These factories in Central Asia are located in remote areas where shipment of fuel involves big expense. With the local supply of waste products sufficient to cover their fuel requirements for half the year, solar energy will take care of the remaining half.

A mirror of 80-square-meter surface has already been manufactured for the Central Asian machine. Dr Molero claims that he will be able to build mirrors many times larger in the near future. He plans to combine several such gigantic mirrors with a view to further increasing their power.

"All fundamental questions pertaining to manufacture of solar-energy converters have already been settled," says Dr Molero. "We are able to produce subassemblies serially for subsequent assembly on the spot. Everything now hinges on their further simplification and reduction of production costs. We are conducting research sponsored by People's Commissariats."

Antifriction Bearings Change Sliding Friction to Rolling





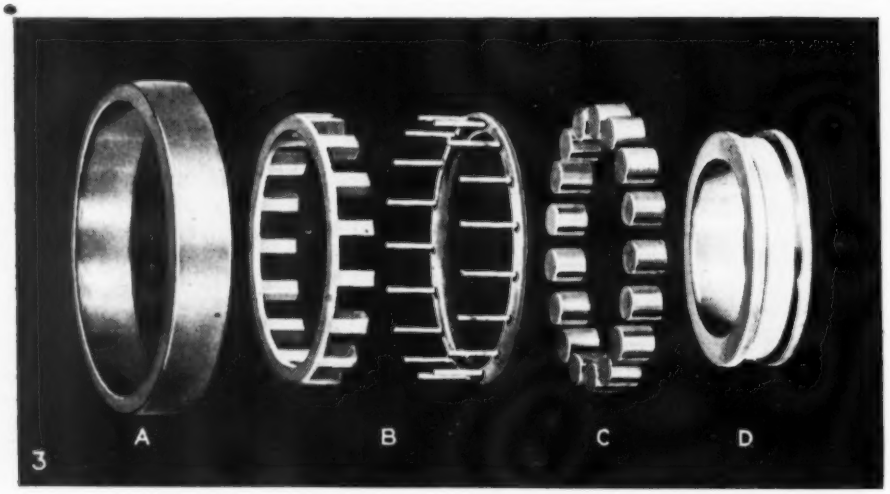


Fig. 1 to 3: Basic parts, antifriction bearings. Fig. 1—BALL BEARINGS: A, outer ring or race; B, retainer to position balls in races; C, balls; D, inner ring or race. Fig. 2—TAPERED-ROLLER BEARING: A, cup or outer ring; B, roll cage; C, tapered rollers; D, cone or inner race. Fig. 3—STRAIGHT-ROLLER BEARING: A, outer ring or race; B, cage for rollers; C, straight rollers; D, inner ring or race

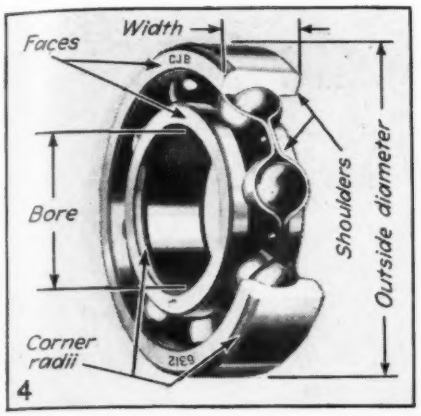
Development of ball and roller bearings, their purpose, advantages, construction, standard parts, and how they transmit radial, thrust and combined radial-thrust loads, told by C W Pearsall, vice-president of Ahlberg Bearing Co

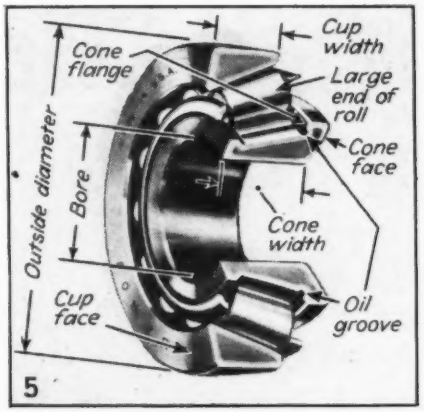
► OUR PREHISTORIC ANCESTORS probably discovered that rolling friction is less than sliding when someone moved a stone or log more easily by rolling than by pulling it. Centuries, later, around 1100 BC, the Egyptians used rollers in moving huge stones from quarries to the sites of their monuments, which are standing today. Still later, Leonardo da Vinci distinguished between sliding and rolling friction at the end of the 15th century, and Benvenuto Cellini wrote that he moved a statue built for the French King by using small wooden balls in the base.

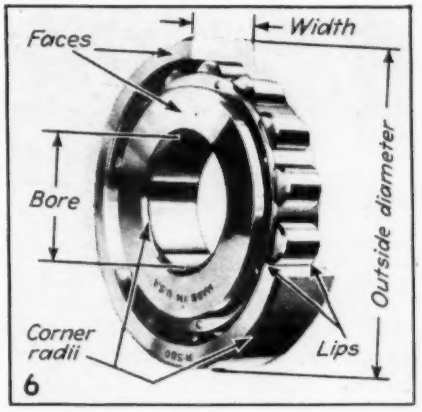
There was, however, no concerted effort to use antifriction bearings until the end of the 18th century. Thereafter friction became a major problem with development of the steam engine and the electric motor, which brought higher speeds and greater bearing loads.

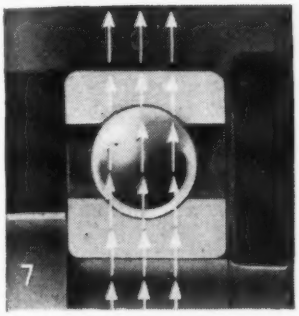
The Bavarian State Railways used ball bearings designed by Baron von Rudorffer in 1847, and during this period we find records of many patents on bearings taken in various countries. An important ball-bearing arrangement for bicycles, patented in 1869 by Suriray, started the ball-bearing era. By 1883 the bicycle was immensely popular in England, and the demand for easier running wheels led to rapid improvements in ball bearings. Conversely, the ball bearing made practical the general use of the bicycle.

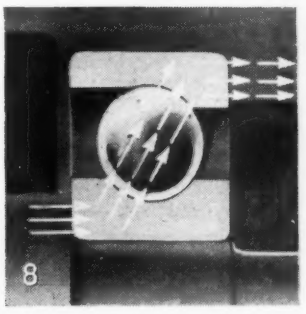
All this time bearings were designed by the trial and error method and very little was done toward putting design on a scientific basis. In 1895 Henry Hertz published his mathematical theories for deformations and stresses produced by pressures between curved surfaces, and in 1900 Professor Stribeck, in Germany, wrote his report, "Ball Bearings for Vari-

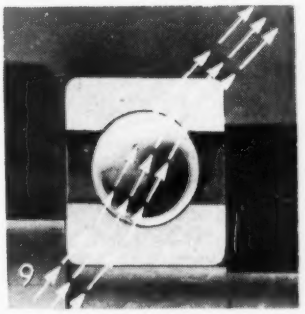


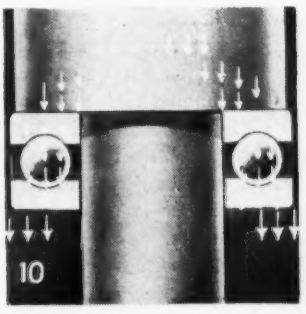


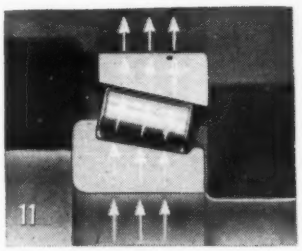


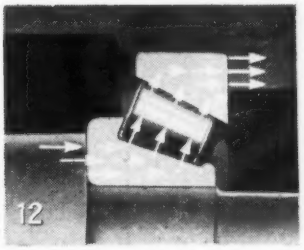


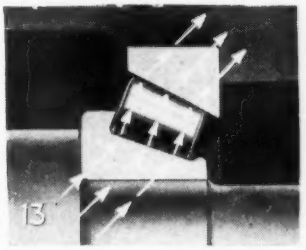












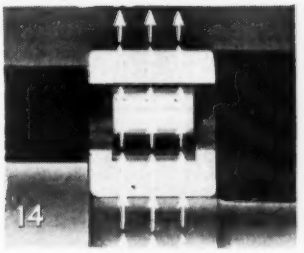


Fig. 4 to 6—Standard names of the parts of ball, tapered-roller and straight-roller bearings respectively. Fig. 7 to 14—How load is transmitted through these three major types of bearings. Fig. 7—Radial load on single-row deep-groove ball bearing. Fig. 8—Thrust load on single-row angle-contact ball bearing. Fig. 9—Angular load on single-row deep-groove ball bearing. Fig. 10—Vertical thrust load only, on ball thrust bearing. Fig. 11—Radial load on tapered-roller bearing. Fig. 12—Thrust load on tapered-roller bearing. Fig. 13—Angular load on tapered-roller bearing. Fig. 14—Radial load only, on straight-roller bearing. Arrows show load direction

ous Loads." He conducted a long series of experiments and tests on actual ball bearings, and his work is the basis for our present-day designs and for calculation of bearing capacities.

Following the bicycle, the invention of the automobile gave impetus to the ball- and roller-bearing industry. The automobile, in turn, accelerated the machine-tool industry, and, as bearing loads and speeds were increased, better bearing materials were required. The first bearings were of soft cast iron, but today the ball- and roller-bearing industry is one of the largest users of high-grade alloy steels and probably one of the most critical of steel quality. To obtain uniform results with these high-grade steels, it was necessary to develop heat-treating methods and equipment, and now the control is so close that the hardness of the parts in a given production run does not vary more than 1 or 2 points on the Rockwell C scale. In general, the industry has standardized on a through-hardened high-carbon high-chrome steel, or a case-hardened nickel-molybdenum steel. Hardness of races, balls and rollers ranges from 60 to 64 Rockwell C scale.

Advantages of antifriction bearings are: low friction, high reliability, reduced maintenance and close clearances that remain so throughout a bearing's life. They can be adjusted to hold gears, grinding wheels or cutting tools in precise position. There is little difference between the running friction of antifriction and plain bearings when they are properly maintained. The coefficient of friction of ball or roller bearings changes very little over a wide range of load and speed, which is not true of plain bearings.

Starting friction of antifriction bearings is also much lower than that of plain bearings. When the shaft in a plain bearing is at rest the lubricant is squeezed out from between them at the load zone. As a result at starting, metal-to-metal contact exists between the shaft and bearing, and it is during this period that the greatest wear occurs. A ball or roller bearing wears little during years of service if properly selected, mounted and lubricated. Since their housing can be effectively sealed to retain oil or grease, antifriction bearings need lubricating at only comparatively long intervals.

Production of a modern ball or roller bearing requires the most precise turning machines, grinders, gages and allied equipment. Tolerances of the rings are in

(*Continued on page* 148)

Treating to Prevent Scale Introduces Carryover Problem

Selection of the treatment for 45% feedwater makeup was dictated by the ability of the process to handle three different waters. Result was heavy sludge in the drums, causing carryover that supplemental treatment and drum redesign cured*

By E M GRIFFITHS
Assistant superintendent, mechanical dept, Republic Steel Corp

▶THE THREE RAW-WATER SOURCES for supplying feedwater makeup to the Youngstown, Ohio, plant of the Republic Steel Corporation are the Mahoning River, city water and purchased industrial water. Characteristics of each are given in Table 1. City water is of good quality but too expensive to justify its use except in an emergency.

The Mahoning River is grossly contaminated by domestic and industrial wastes and its chemical composition varies widely, hardness fluctuating from 100 to 300 ppm, of which 70 to 80% may be non-carbonate. At times the water is highly turbid and has other objectionable qualities. But since there is not enough other water available, the stream serves as a source of feedwater (2400 gpm) for original units in the old boilerhouses.

Quality of the purchased industrial supply is far superior to Mahoning River water and fluctuations in its chemical composition take place more slowly. Enough is available for a maximum demand of 600 gpm, so it was recommended that this water be used exclusively in our new boilers. An emergency connection was made to the city mains.

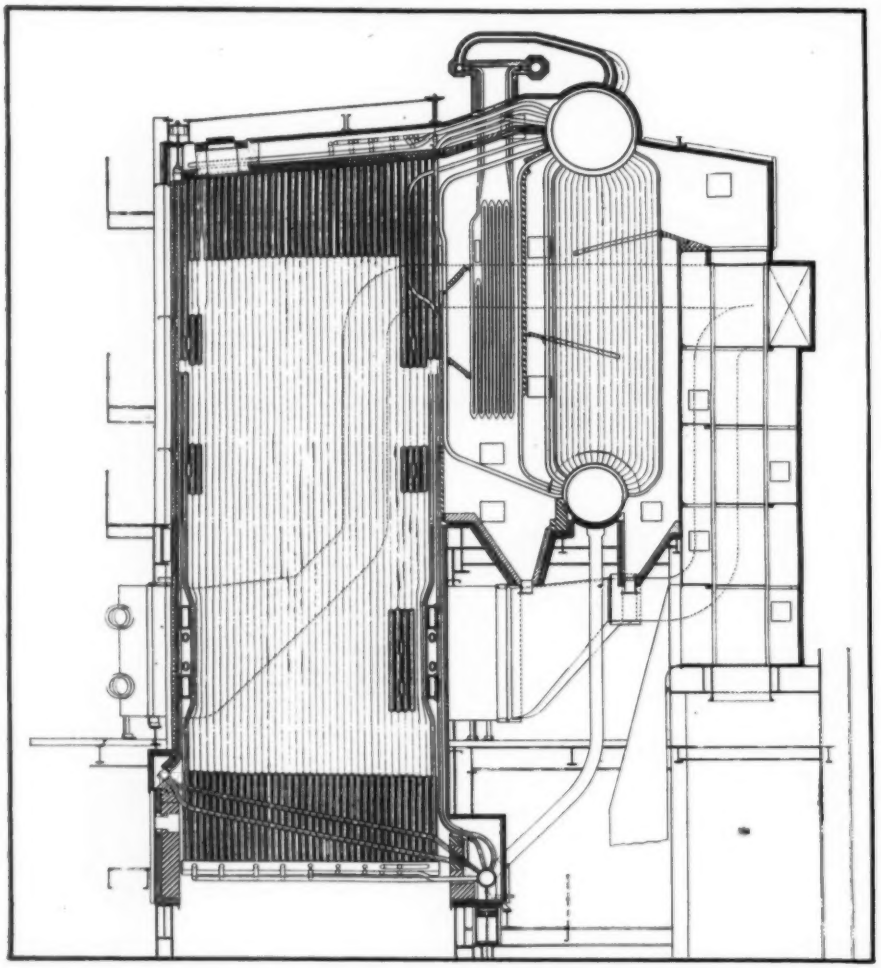


Fig. 1—The 2-drum bent-tube boilers use a watercooled furnace consisting of 3-in. tubes. Furnace-heat release is 21,000 Btu per cu ft per hr at maximum rating

The Bessemer plant contains seventeen 150-psi 464-hp Stirling boilers, fired by forced-draft stokers and supplying 350,000 lb per hr of steam for reciprocating engines. Tracy purifiers clean the steam, outlet being on each middle drum. The blast-furnace plant, No. 2 house, has twenty-three 150-psi 464-hp Stirling boilers equipped with natural-draft blast-furnace gas burners; No. 3 house has four 1260-hp 200-psi Stirling boilers fired with forced-draft blast-furnace gas burners; No. 4 house has four 1130-hp 200-psi straight-tube 4-drum boilers with underfeed stokers. Drums of the latter are fitted with Tracy purifiers. Steam outlet on the Stirling boilers, originally on the middle drum, was moved to the back drum because wide variations in gas-fuel pressure caused considerable carryover.

Drums Connected

Cross circulators between drums on the 4-drum boilers corrected water-level variation between drums, improved circulation, distributed sludge and dissolved solids more uniformly, and improved steam quality. Steam demand from blast-furnace boilers is 900,000 lb per hr to supply furnace blowers, and mill engines, and for miscellaneous uses.

Old boilers are all fed from a central intermittent cold lime-soda system, Fig. 2. Sodium aluminate serves as a coagulant. Quantity of lime and soda ash for each succeeding batch of water is determined from alkalinity and hardness tests made on the previous one unless the raw-water composition changes. Then the chemical

* Abstract of a paper delivered at the 5th Annual Water Conference, Engineers Society of Western Pennsylvania, Oct. 31, 1944.

feed is readjusted. Since completion of the Berlin and Mosquito Creek reservoirs, river flow is controlled and changes in raw water are not so rapid. This makes treatment easier. Amount of sodium aluminate is governed by the turbidity of water going to the filter beds and also by the hardness reduction needed. Treated effluent varies from 14- to 27-ppm hardness with an average of 16 ppm. Tannic acid, added to the clearwell at the rate of 3 to 5 ppm. reduces feed-line deposits and increases the fluidity of sludge in the boilers, which simplifies its removal by blowdown.

Because water leaving the treating plant still contains scale-forming material, secondary correction within the boilers is necessary. To do this effectively and simply for the 48 boilers we pump an acid-phosphate-protein solution into the treated-water outlet from the central treating plant. Pump operates from one to seven minutes at half-hour intervals depending on boiler-water test results. An automatic timer controls the pumping periods. Regulation obtained with this common feed is quite effective for there is seldom more than 35-ppm difference in excess phosphate between the boilers.

Continuous blowdown maintains concentration at 4000 and 5000 ppm on the 200- and 150-psi boilers respectively. (Limits are determined by specific conductance tests on condensed steam samples.) Samples of water from each boiler are tested daily, after which settings are adjusted on phosphate feed and continuous blowdown valves. Some boilers are turbined once a year, removing about 550 lb of scale and sludge from a 464-hp unit. Others are cleaned with inhibited hydrochloric acid to reduce outage time and save blast-furnace gas that otherwise would be wasted. Boilers equipped with underfeed stokers are taken off at 45-day intervals for stoker repairs, and boiler drums are washed during the outage. Units fired with blast-furnace gas are taken off about three times a year for external cleaning and washing of boiler drums.

When river water was used without any treatment, about 16,600 lb of scale were removed each year from a 464-hp boiler. It was necessary to take out some tubes because a cleaning tool could not be put through them. After the treating plant was installed and prior to the present control, set up in 1930, hardness of the treated water usually was around 40 to 50 ppm and boilers were turbined twice yearly, about 3140 lb of scale being removed per year per boiler.

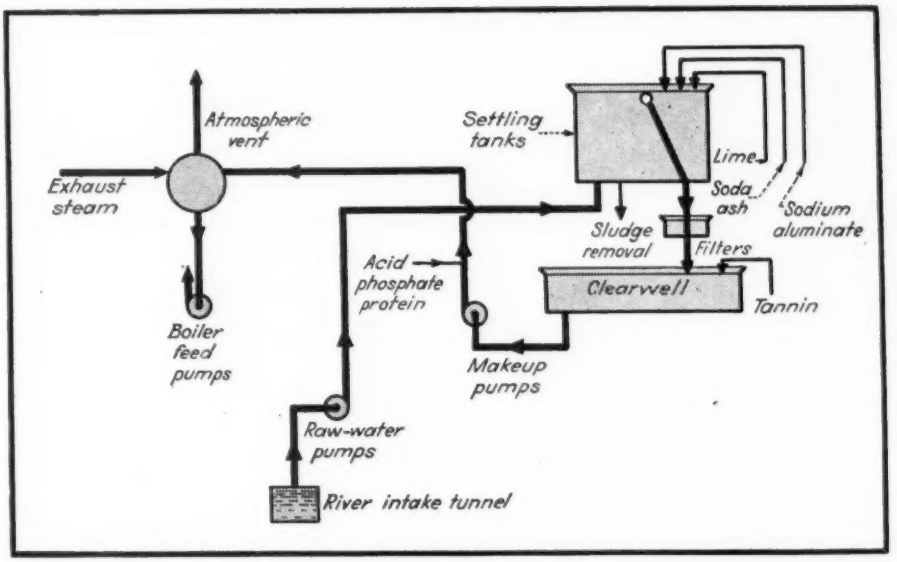


Fig. 2—Feedwater makeup for the old boilers comes from an intermittent cold lime-soda process. Sodium aluminate coagulant facilitates settling of the precipitate

Because active corrosion has never been a problem no treatment is provided. However, detectors in the lines are checked every 60 days for evidence of corrosion. Sulphate-alkalinity ratio varies between 2.1 to 1 and 5.5 to 1, which conforms to the present ASME Code. A series of Schroeder caustic-embrittlement detectors covering 30, 60, 90 and 120 days duration are installed but they show no signs of embrittlement.

In 1942 the Defense Plant Corp constructed a new power station at the blast-furnace works. Major units include two 850-psi 860-F 150,000-lb-per-hr boilers, two 90,000-cfm turbine-driven blowers (steam pressure 200 psi) and a 7500-kw 850-psi turbine-generator exhausting into the 200-psi main.

Steam-generating units are 2-drum bent-tube design with 3-in. tube waterwalls. Furnace heat release is 21,000 Btu per cu ft per hour at maximum rating. Main steaming tubes between drums are 3-in. and downcomer tubes 2 in. in diameter. Pendant superheaters hang immediately beyond rear waterwall screen tubes. Waterwall and boiler-heating surfaces are 5595 and 9240 sq ft respectively. Combination tangential burners for blast-furnace gas and oil are located in each corner of the furnace.

High-pressure boilers require control of boiler-water composition within much

Table I—Analysis in Ppm of Raw-Water Supplies

Average of 64 tests

Characteristics	*Mahoning River*	*City water*	*Purchased water*
pH	....	10.2	7.1
Odor	Sewage	....	....
Color	No. 60	....	....
Turbidity	100	....	....
Organic matter	10	....	....
Suspended matter	....	0.06	0.06
Characteristics as ions			
Calcium	64.5	21.7	18.6
Magnesium	21.7	5.4	5.9
Sodium	73.0	30.0	9.5
Bicarbonates	122.0	50.0	52.0
Carbon dioxide	20.0	....	....
Hydroxide	....	....	....
Sulphates	185.0	88.1	35.5
Chloride	50.0	7.3	8.3
Silica	25.0	5.5	4.6
Iron & alumina	7.2	2.2	2.6
Total (as ions)	568.4	210.2	137.0
Characteristics as CaCO			
Calcium hardness	161.0	54.3	46.3
Magnesium hardness	89.0	22.5	24.2
Total hardness	250.0	76.8	70.5
Bicarbonates	100.0	41.0	42.6
Non-carbonate hardness	150.0	35.8	27.9

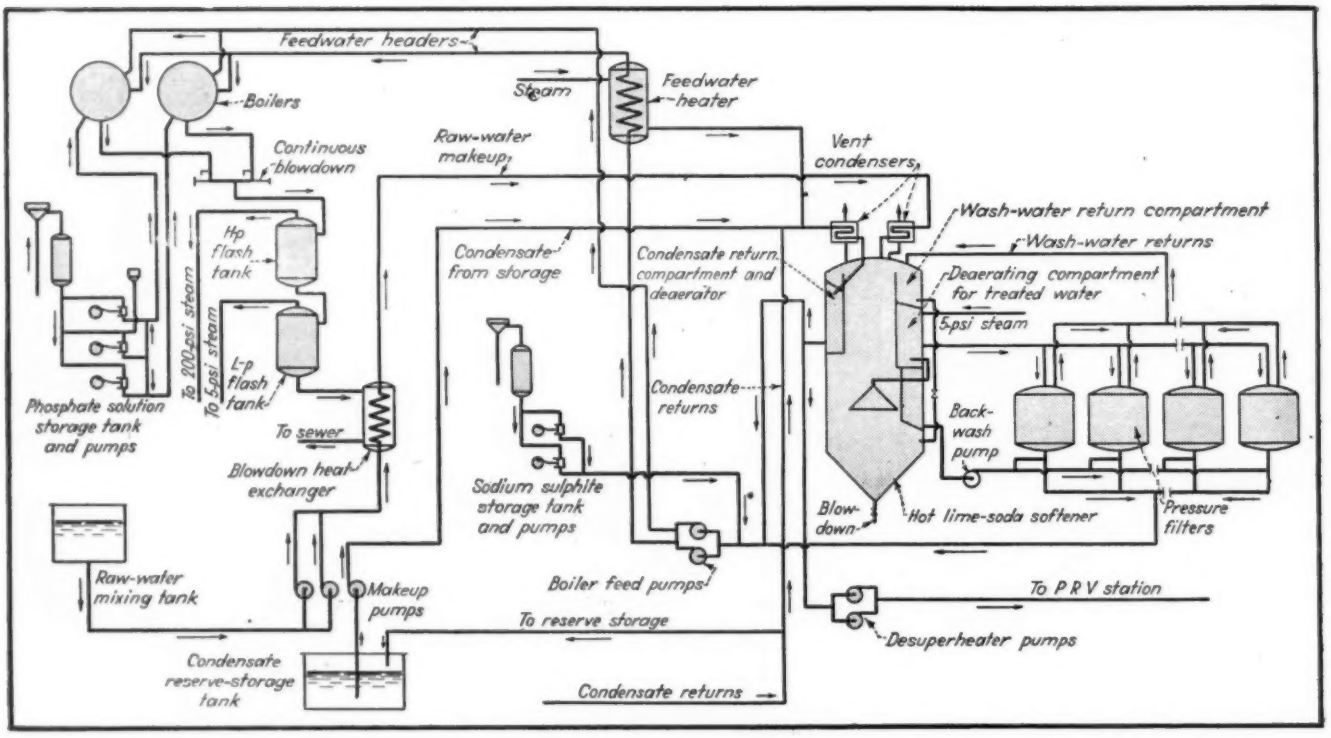


Fig. 3—The hot lime-soda process for the new boilers consists of a treating and settling tank with separate heating, deaerating and storage compartments for the treated water, and chemical feeders, filters and filter backwash pump

closer tolerances than low-pressure units to prevent scale, corrosion, carryover and other operating difficulties that might lead to destruction or deterioration of equipment. Therefore, suspended matter, oil, corrosive substances and silica must be eliminated, neutralized or reduced. A supplemental phosphate treatment within the boiler precipitates the remaining hardness as a soft sludge instead of an adherent scale. But sludge removal by blowing down and periodical boiler cleaning, during which blast-furnace gas is wasted causes a loss in power production. Consequently, supplemental treatment that minimizes sludge lengthens the intervals between cleanings.

Before selecting the type of feedwater treatment we made a comprehensive study of raw-water supplies and the various types of treatment available. Methods considered were: (1) coagulation, filtration and softening with zeolite units (2) a system similar to 1, but operated in the acid and sodium cycle (3) hot-process softeners.

Investigation of various systems in a number of plants revealed that regardless of the system employed, whether based on softening by chemicals or zeolites, it was necessary in every instance to take boilers out of service at intervals of two to four months to remove accumulated sludge from steam-washing apparatus, drums and tubes.

In view of these findings and after careful investigation of the suitability, cost and space requirements of the zeolite and hot-process systems, the latter was selected for these reasons:

1. Operators are familiar with principle of softening by lime and soda ash.
2. Investment is lower.
3. Plant arrangement is simple and compact.
4. Less water is wasted.
5. Softening and deaeration are effected in single apparatus.
6. Simultaneously with softening, silica is reduced.
7. System is readily adaptable for treating any water supplies available.
8. Use of sulphuric acid is avoided, a safety factor.
9. System is fairly comparable with more complicated systems.

The softener consists of (1) treatment and settling tank with separate heating, deaerating and storage compartments for treated water and return wash-water and other special features (2) two proportioning wet-chemical feeders for lime and soda ash (3) four pressure filters and (4) backwash pump and various accessories. Fig. 3 shows an over-all flow diagram of the feedwater system.

Protection against corrosion of boiler tubes and drums means complete elimination of dissolved oxygen from the feedwater. Efficiency of deaerating heaters may be impaired temporarily or oxygen may enter the system with chemical solutions or be entrained through minor leaks. For this reason the deaerated feedwater is continuously treated with sodium sulphite to remove dissolved oxygen.

Equipment consists of a sulphite-solution storage tank fitted with a bubbler seal to admit air without exposing the main body of liquid to the atmosphere, which weakens the solution. Two pumps (one is a spare) with adjustable delivery discharge sulphite into the feedwater-pump suction. For secondary softening treatment, disodium phosphate is pumped into each boiler's top drum.

Phosphate feeding system consists of: (1) phosphate-solution tank (2) three duplex-piston pumps (3) motor-operated 3-way valve connected to the suction of each pump, which supplies either phosphate solution or cold condensate for flushing the lines (4) automatic timer for each pump and 3-way valve for starting, timing, valve positioning and resetting for the next operation. All pumps can be operated manually if necessary (5) mercoid switch in the feedwater-meter totalizer of each boiler to send an impulse to the timer for every 100,000 lb of feedwater. The limits of feedwater chemicals in Table II serve as a guide for the treatment dosage.

Treated water is tested every three hours for lime-and-soda-ash dosage and hardness. The feedwater, a mixture of condensate and treated water, is checked for hardness, alkalinity and pH twice

daily. Water from each boiler is sampled every three hours for sulphite, phosphate and total concentration, and twice daily for alkalinity.

Using only lime and soda ash in the reaction tank, total hardness of the treated water ranged from 12 to 17 ppm. Later we began adding a refined sodium aluminate, mixing the compound with the lime slurry to determine whether it would reduce sludge formation in the boilers. This produced a lower residual hardness in the treated water from 8 to 12 ppm.

Early internal inspection of the boilers showed the tubes coated with a light deposit of tri-calcium phosphate, which was easily removed by wiping with a wet rag. Hoods and elements of the steam washer were coated with sludge varying from 1/16 to 1 in. thick and indications showed that the material sloughed off when it became too thick. Sludge also covered much of the drum surface and internal parts above normal water level. Most of the holes in the continuous blowdown collector were found plugged.

Soft sludge in the mud drum and bottoms of waterwall headers evidently was brought down when the boiler was drained. Observation of these internal conditions, after operating periods of varying length, led to the decision to take the boilers off every three months for cleaning.

We believe the sloughing off of thick sludge accumulations accounted for the highly varying turbidity of boiling-water samples taken from the continuous blowdown line. This usually occurred upon rapid changes in heat input to the boiler, caused by severe variations in blast-furnace gas pressure. At the start of these high turbid conditions ¼ in. of sludge would settle in a 400-ml beaker. We had to reduce the boiler-water total concentration to 800 ppm to prevent carryover during periods when sludge sloughed off and increased the turbidity.

To prevent carryover and correct the heavy sludge condition, the drum internal arrangement was changed. Principal revisions included replacing the steam washer with steam and water separating hoods, moving the feedwater inlet down under the water surface, increasing the drying-screen area and enlarging the blowdown collector-pipe holes from ⅛ to ½ in. Automatic control was installed to smooth out pressure variations in the blast-furnace gas that was used as fuel.

Internal inspection of the boilers after these changes shows less phosphate sludge than had previously accumulated in any comparable operating period. This was particularly noticeable in both top and bottom drums. Deposits in all tubes are soft and can be removed easily by washing with a water spray. Also blowdown water is turbid a far greater part of the time, indicating that sludge removal is better. No corrosion has been found on internal boiler surfaces.

Sodium aluminate has materially reduced sludge deposits on tubes and drums. The operating period has been extended gradually from 3 to 6½ months, while using about 45% makeup. The sodium aluminate reduced to a minimum the magnesium hardness that apparently was responsible for the sticky adherence of sludge to all of the boiler surfaces.

Table II—Feedwater Treatment Guide

Limits of feedwater chemicals to guide treatment

Chemical	*Ppm*
Lime	0 to 10
Soda ash	25 to 42 (over final treated-water hardness)
Sodium aluminate	5 to 10

Complete treatment maintains the boiler water at these conditions

Final Condition	*Ppm*
Total solids	1500 (approximately)
Excess phosphate (PO_4)	20 to 40
Excess sodium sulphite	10 to 20
Alkalinity	400 to 500
pH—11.2	

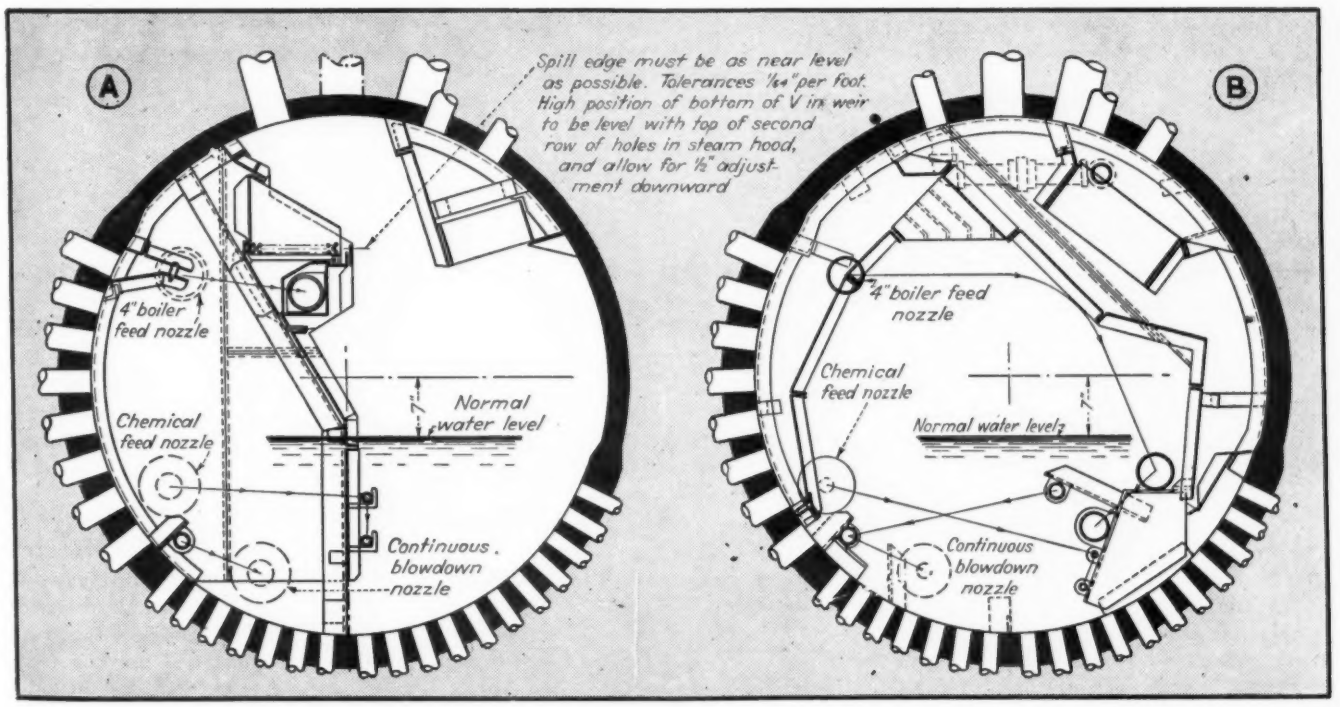

A
Spill edge must be as near level as possible. Tolerances 1/64" per foot. High position of bottom of V in weir to be level with top of second row of holes in steam hood, and allow for ½" adjustment downward
4" boiler feed nozzle
Chemical feed nozzle
7"
Normal water level
Continuous blowdown nozzle
B
4" boiler feed nozzle
Chemical feed nozzle
Normal water level
7"
Continuous blowdown nozzle

Fig. 4—Drum redesign, B, included replacing the steam washer with steam and water-separating hoods, moving feedwater inlet down under water surface, increasing the drying screen area and enlarging the holes in blowdown pipe

SHORT CUTS TO PLANT EFFICIENCY

By W A SHOUDY

No. 1—What Steam Pressure?

In this practical series, based on engineering fundamentals, long experience and common sense, a consulting engineer shows how to design an economical plant for process steam and power. Fixing steam pressure is an early, important step

► FOUR RULES GOVERN design and operation of any steam power plant: (1) Select and maintain the highest practical steam pressure and temperature. (2) Select and maintain the lowest practical backpressure. (3) Select and maintain the highest practical steam-generating efficiency. (4) Prevent as far as practicable all miscellaneous wastes.

A steam-power problem has two parts: (1) using steam with the least possible waste and (2) delivering to the steam as much of the fuel's heat as possible.

It is the use to which steam is put that determines pressure and temperature as well as plant economy. Boiler efficiency should be as high as possible but not at the expense of a suitable pressure, which is even more important.

Use of Exhaust Steam

If a plant cannot furnish any exhaust steam for manufacturing, select the highest available throttle pressure and temperature and the highest vacuum the cooling water permits. But we are not here concerned with that type of plant. Unless exhaust steam can be utilized it is rare that an industrial power plant generates electrical power at a total cost as low as it can be purchased. Cost of fuel, labor and maintenance may be less than purchased power, but when interest, depreciation, taxes, etc, are added, total cost is generally too high.

So we are concerned only with a steam power plant that must supply *both* steam and electrical power to a factory. If it is correctly designed and operated cost of the electrical power is often so low that no public utility can compete. The reason is that the heat wasted in the exhaust steam is recovered.

When all exhaust steam is utilized for heating or manufacturing, power generated becomes a byproduct of the manufacturing steam. The only part of the throttle-steam heat that is actually consumed for such byproduct power is the heat converted to power (3413 Btu per kwhr) plus the heat lost in the turbine bearings (about 2%) plus the heat lost in the generator (about 5%) plus the heat lost in radiation (so small it can be forgotten).

Heat lost in bearing friction is constant regardless of load. It is lowest, in percent, in large turbines, and varies with the condition of the bearings. Heat lost in the generator increases in percent at low loads.

Expressing mechanical efficiency in decimals as ME and generator efficiency as GE, the formula becomes:

Btu per kwhr used by turbine, or engine, to generate power from manufacturing steam =

$$3413 + (1\text{-}GE)\,3413 + (1\text{-}ME)\,3413 + (\text{radiation} + \text{kw load})$$

Seldom does an industrial power-plant designer know factory steam requirements closer than 5 or 10%. So it seems unnecessary to use this exact formula when one with a possible maximum error of not more than 2% is satisfactory. The condensed formula then becomes:

$$\text{Btu per kwhr used by turbine} = \frac{3413}{ME \times GE}$$

In preliminary estimates we do not always know exactly the generator efficiency or the mechanical loss. A new turbine should have some spare capacity; for some time it will operate at about three-quarters load. The efficiencies will also be lower in the smaller sizes. Safe estimating efficiencies at three-quarters load may be taken as: generator efficiency, 92%, and mechanical efficiency, 97%. So the formula becomes:

Btu per kwhr used by turbine to generate power from manufacturing steam =

$$\frac{3413}{0.92 \times 0.97} = 3825$$

Steam-generating efficiency may be taken as 75% for natural draft and 82% for induced draft with economizers or air heaters. Dividing these efficiencies (in decimals) into 3825 we have:

Btu per kwhr used by boiler and turbine to generate power with manufacturing steam:

With natural draft =
$3825 \div 0.75 = 5100$ Btu per kwhr

With induced draft =
$3825 \div 0.82 = 4665$ Btu per kwhr

The round number, 5,000 Btu per kwhr, is easy to remember and, with natural draft, close enough for quick estimating. Dividing it by the heating value of average coal as fired, say, 13,000 Btu per lb. gives 0.385 lb of coal per kwhr.

With induced draft and 14,000 Btu coal, the exact figure becomes 0.333. It is easy to remember that byproduct power costs from ⅓ to 2/5 lb of coal per kwhr. For coals of very low heating value it may reach ½ lb.

This cheap power can be obtained *only* if *all* exhaust steam is used. Every kwhr generated by steam wasted to atmosphere costs from 2 to 5 lb of coal.

Maximum exhaust-steam demand seldom occurs at the time of maximum turbine load. Accordingly, study both the steam- and electrical-load curves. If these are not available, determine the time and amount of maximum electrical power demand and the amount of exhaust steam that can be utilized at this time.

Suppose the maximum electrical load is expected to be 1200 kw and at that hour the factory requires 30,000 lb per hr of steam. If it needs this steam at 15 psi, allow for a pressure drop between the turbine and the factory apparatus. Let us add 5 psi, making the exhaust pressure 20 psi. If we divide the lb-per-hr of steam by the kw, the turbine should have a steam rate not exceeding 25 lb per kwhr to avoid waste of exhaust steam at this load.

Charts Save Time

Using the charts published in Nov 1945 POWER, pp 87 to 94, saves much time. With 200 psi at the throttle, the Nov chart, p 88, shows that 30,000 lb per hr of steam will generate 900 kw—not enough. With 375-psi throttle pressure the same steam generates 1220 kw. This is still pretty tight. If throttle pressure is raised to 400 psi the possible kw-load will be raised to 1260 kw. But if exhaust pressure is dropped only 5 psi—to 15-psi backpressure—turbine output will be raised to 1380 kw. Thus 5-psi backpressure drop has gained more power than a 25-psi rise in throttle pressure.

Probably the factory does not need 15 psi. It can get along on 7 psi but wants to play safe. Now is the time to discuss this pressure with the management and reach an agreement as to the amount needed—also to review all load data to be sure that the estimated loads, both present and ultimate, are correct. Study low-load and average-load periods in the same way. When these studies are completed check your estimated steam rates with the turbine manufacturer to determine their accuracy.

Results of such a study of one typical day are plotted in Fig. 1. Assume a client whose factory was generating low-pressure steam in boilers that had been condemned, and was buying electrical power. Before buying new boilers the management wished to know whether they could generate their electrical requirements economically and what boiler pressure to select if a turbine were installed at a later date.

Fortunately there were flowmeter and wattmeter records for several years. Factory-production records for several years were studied to determine the trend in output. This rate was compared with the rate of growth of both steam and elecrical loads and, after consultation with the management, a hypothetical year was developed as representing the probable ultimate power and steam requirements.

Meter charts of several years were inspected and typical ones selected. Great care was used to find the time and size of unusually heavy electrical loads or any particularly low steam demands. The ratio of lb per hr of steam to kw load was computed for a large number of load conditions, and the smallest ratio selected as indicating the steam rate required of the proposed turbine. Using this rate, the correct throttle pressure and temperature were determined as in Fig. 2.

Curves Illustrate Problem

Fig. 1 was prepared to illustrate the problem to the client. Upper curve *A* is a plot of the actual steam the factory used on a typical day; lower curve *D* is a plot of the electrical load for the same day. Lines *b* and *c* (lower left) are the willans lines for the proposed turbine; that is, throttle flow plotted against kw load. Upper lines *B* and *C* show the steam that would be exhausted by a turbine operating under the loads indicated by curve *D* with steam conditions as follows:

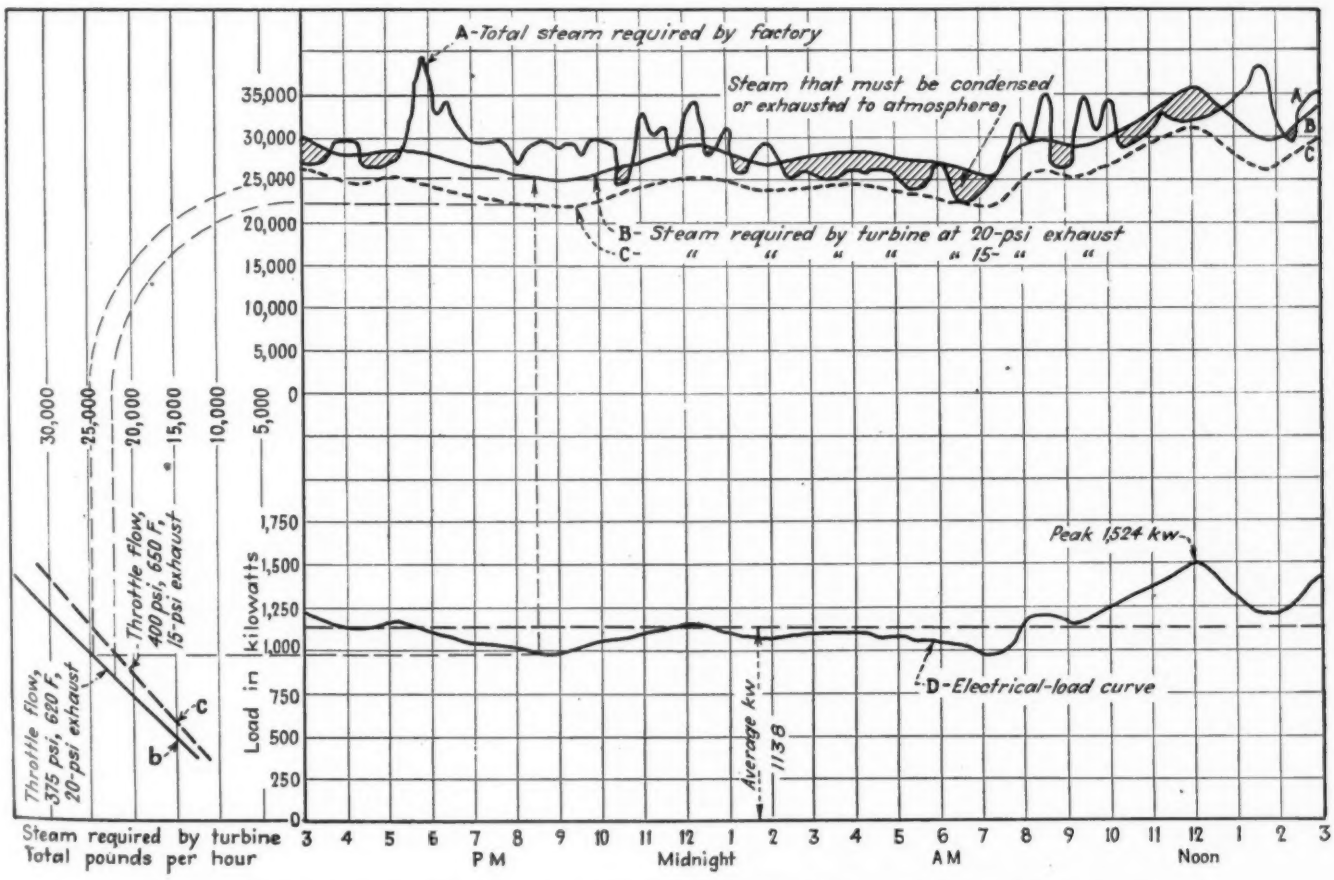

A-Total steam required by factory
Steam that must be condensed or exhausted to atmosphere
B- Steam required by turbine at 20-psi exhaust
C- " " " " " 15- " "
Peak 1,524 kw
D-Electrical-load curve
Average kw
1138
Throttle flow, 400 psi, 650 F, 15-psi exhaust
Throttle flow, 375 psi, 620 F, 20-psi exhaust
Load in kilowatts
Steam required by turbine
Total pounds per hour
PM
Midnight
AM
Noon

Fig. 1—Plot of steam and electrical loads that will determine the throttle pressure and temperature

1. Curve *B*, 375 psi, 620 F at the throttle, 20-psi exhaust pressure.

2. Curve *C*, 400 psi, 650 F at the throttle, 15-psi exhaust pressure.

Temperatures were selected to give approximately saturated steam in the exhaust for each throttle pressure.

Wherever curve *A* falls below *B* turbine exhaust is greater than the factory steam demands. This excess is lost or it must be condensed. That is, a bleeder condensing turbine should be used.

Curve *C* shows the exhaust steam available if throttle pressure is raised to 400 psi and exhaust pressure lowered to 15 psi—the lowest pressure that the factory can use.

Play Safe on Pressure

At no hour of the day does curve *A* fall as low as curve *C;* hence all electrical power can be generated by the steam the factory needs. For long periods there is not enough exhaust steam to supply the factory, but the deficiency can be made up with live steam from reducing valves.

The curves show that for this particular day the correct throttle pressure is 400 psi. If we were sure that the electrical load would not grow faster than the steam demands we could settle on this pressure for boilers, turbine and piping. Generally the reverse is true. New electrically driven machines appear that cut costs and the steam-electrical-power ratio is reduced, thus requiring either a higher throttle pressure or a bleeder condensing turbine.

Data for this illustration were selected because it is a border-line case and because, though the kw load is quite uniform, steam demands are very irregular. When steam and electrical loads follow each other closely the problem is less difficult.

Well-kept operating records usually save money in buying new equipment, and fortunately this plant's steam and power records were quite complete. Without such records an engineer is forced to use his best judgment and play safe; that is, buy more expensive equipment than would be needed if accurate data were available.

Three Choices for Pressure

It is well to select a boiler pressure as far above the throttle pressure as practicable. In normal times the three choices of piping pressures are: 250 psi, cast-iron valves and fittings, 475 F; 400 psi, steel, 750 F; 600 psi, steel, 750 F. Higher pressures need special discussion. The 300-psi steel valves and fittings are used principally for lower pressures at temperatures above 500 F.

Cost increase of the power plant due to higher steam pressures is the cost increase of piping, turbine, boiler superheater and economizer. All other costs remain the same regardless of steam pressure. It is safe to estimate that cost of a 400-psi plant will not exceed 110% of the cost of a 250-psi plant, and that another 10% will more than cover a 600-psi plant.

Until the ratio of factory steam to electrical power gets so small that a pressure higher than 600 psi is necessary, it is desirable to divide industrial boilers into three classes based on pressure at the superheater outlet: 250, 400 and 600 psi. To provide for the pressure drop through the superheater add 30 psi or, better, 50. If an intermediate pressure is selected the only saving in cost is from slightly thinner drums and tubes. Cost of turbines steps up at 251-, 401- and 601-psi throttle pressure, except that slightly higher pressures can be used if steam temperatures are lowered. It is wise to specify drum pressures of 300, 450 or 650 psi so if load conditions change there will be no limit due to boiler design.

When the required operating pressure is as low as 150 psi, and there seems little probability of change in the ratio of steam to power, it may not be necessary to purchase 300-psi boilers. Volume of a pound of steam at 150 psi is almost twice that of 300-psi steam; hence the steam nozzle should have an area sufficient for the lower pressure. If the boiler is to operate at 50% of the design pressure, the manufacturer should guarantee performance at both pressures.

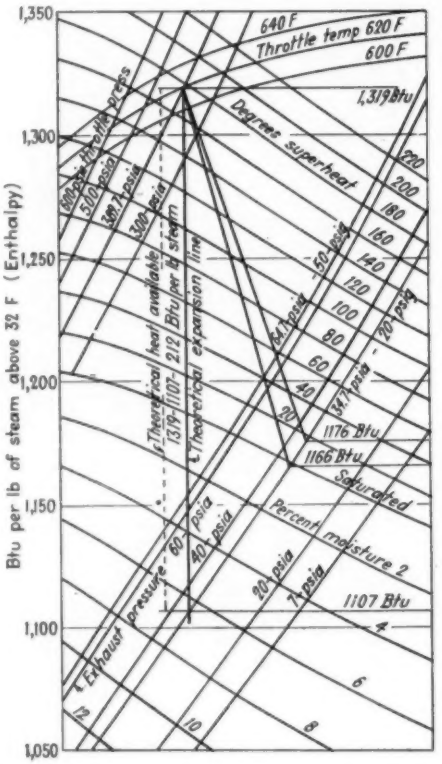


Fig. 2—Section of a Mollier chart in skeleton form. The lines are for the problem worked out in the text, page 93

Throttle Temperature

Steam temperature at the throttle is determined by the amount of superheat permitted in the turbine exhaust. Generally 10 to 20 deg is not harmful because some of this superheat will be lost through radiation in the piping. Superheat is always higher at half than at full load. We must determine maximum temperature the factory permits and select a throttle temperature that keeps exhaust temperature below the permissible limit when the turbine is running at the lowest expected load. Approximate throttle temperatures are given on the charts in Nov POWER. For more exact figures use the Mollier or Btu-entropy chart, furnished with standard steam tables.

A practicable engineer should not let the mystic label *entropy* deter him from using this convenient chart. Why should he bother about the definition of entropy if he knows how to use it? No one has to know the derivation of 3.1416 to figure a circle's area.

When steam expands in a perfect engine or turbine no heat is lost by radiation and none is received from the outside. All heat released is converted to work. Such ideal expansion is called *adiabatic* or at *constant entropy* or *isentropic*. On the Mollier diagram the constant-entropy lines are straight and *vertical; hence ideal expansion is represented on the diagram by a vertical straight line*. On the same diagram there are lines plotted to show enthalpy, steam pressure and temperature, superheat and moisture. It is a complete steam table that has been plotted in chart form instead of tabulated.

Use of Mollier Chart

Fig. 2 is a section of a Mollier diagram from which, for clarity, all unused lines have been omitted, and on which a turbine problem has been worked out.

Steam conditions are taken at the throttle as 375 psi (389.7 psia) 620 F (178-F superheat) and exhaust or backpressure 20 psi (34.7 psia). Locate the point for 389.7 psia and 620 F, and draw a line vertically downward until it intersects the 34.7-psia line.

This point is the end of the theoretical expansion line. The horizontal line of the chart cutting this point shows an enthalpy of 1107 Btu. Difference between

(*Continued on page* 160)

Storing and Handling Methods That Keep Good Oil Good

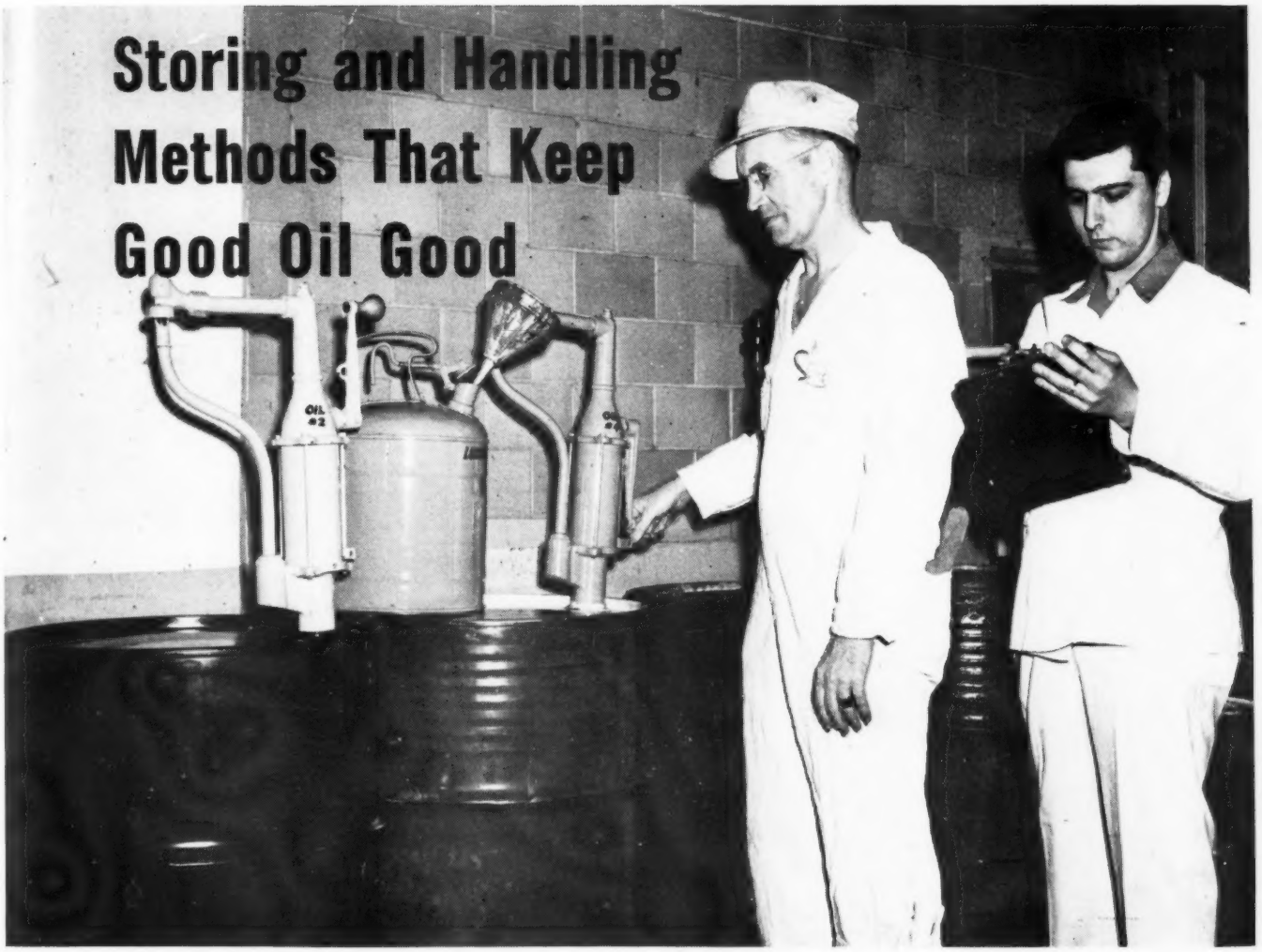


Fig. 1—Suitable pumps equipped with spring-return drain lines withdraw oil directly from refinery-filled drums

Lubrication engineers of Joseph E Seagram & Sons take no chances with oils and grease becoming contaminated. They adopted a storage and handling system that protects the lubricants and reduces maintenance costs. Here are details of their system reported by A J Strohmaier, J C Halbrook and R B Akell

► IMPORTANCE OF CLEAN STORAGE of lubricants and handling methods that prevent contamination cannot be overemphasized. Manufacturers take great care to deliver their products in good condition to the consumer, but their efforts are mostly wasted if oil and grease are handled by haphazard methods in the plant.

Many maintenance mechanics on trouble-shooting missions have come across extensive damage caused by using contaminated lubricants. Almost every one of these troubles can be avoided if a little attention is given to the proper handling and application of lubricating oil and grease. Before showing how this job is done in our industrial plant, let us first consider how oil and grease become contaminated.

The most harmful contamination of lubricants is caused by the presence of foreign particles. Abrasive and corrosive in nature, they are always present where poor housekeeping prevails.

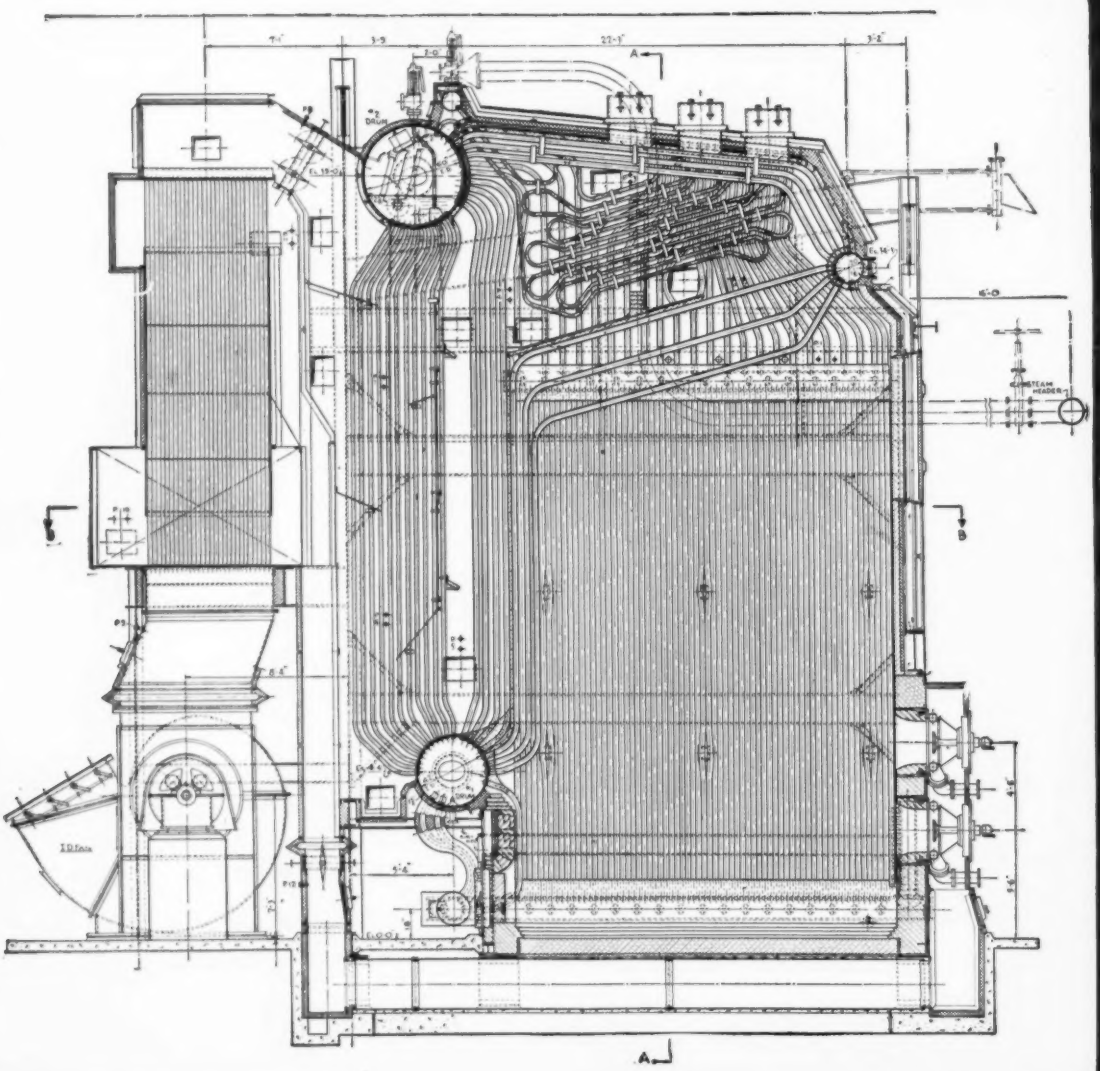
Bulk oil stored in steel tanks, badly rusted inside, or with missing lids, dirty depth gages and return drains, will be full of grit and dirt. The use of rubber hoses around oil storage is poor practice where high-grade oil products are used. This is especially true of natural rubber because oil easily becomes contaminated from the decomposed rubber.

Grease collects dust or abrasives from the air when left uncovered or exposed. Next time you see an open grease can rub your finger lightly over the surface, and you will be surprised at the abrasive in the so-called lubricant. Open dispensing cans also collect dust from the air. Collection of dust may always be seen at the bottom of an open oil can that has been left around.

Another contamination is caused by mixing lubricants during handling or oiling in the plant. Although this form of contamination is not so bad as the presence of foreign particles it is serious enough for consideration. Oil stored or handled in small unmarked containers soon becomes indifferently mixed or applied. These conditions result in corroded bearings and improper lubrication and are inexcusable in any plant.

(*Continued on page* 98)

Add two More Riley Units



300,000 lbs./hr. Riley Steam Generating Units
500 lbs. Pressure—750° F. Total Steam Temperature
Fired by Natural Gas and Oil

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Cleveland Detroit Chicago St. Louis Cincinnati
St. Paul Kansas City Denver Seattle Portland Los Angeles Houston New Orleans Atlanta Memphis

It will pay you to visit modern Riley Installations

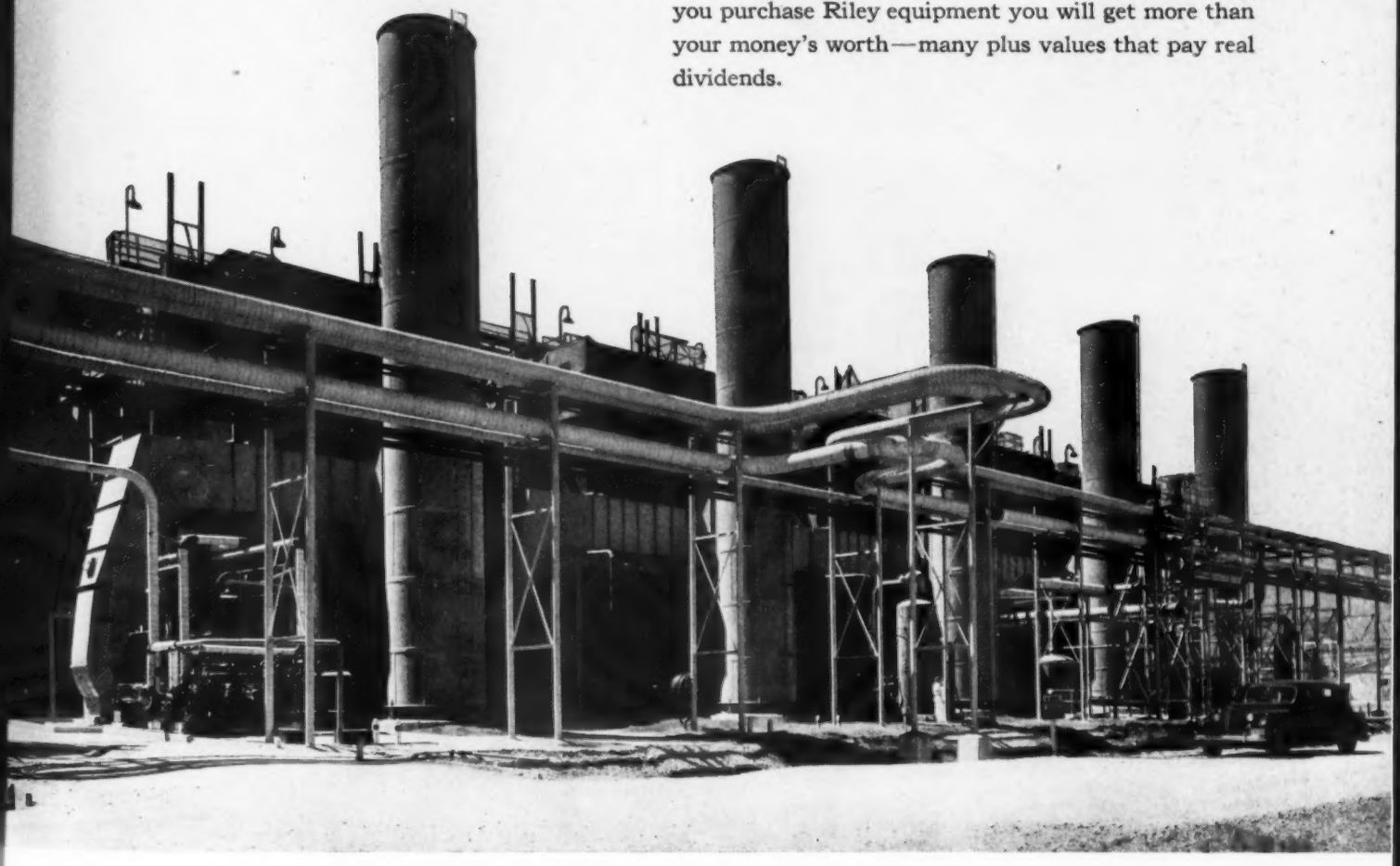
to this existing line of five

Four orders for Riley Steam Generating Units from this one plant

Next summer when the two duplicate Riley Steam Generating Units, now on order, are installed, there will be a total of seven Riley units in this plant having a total steam generating capacity of 2,100,000 pounds per hour. The first three Riley units were installed in 1940. Two additional units were installed in 1941. The sixth and seventh units will be installed this summer.

In addition to these seven Riley units, this company, one of the largest producers of magnesium in the world, has installed six additional Riley units in their other plants. Two of these units have a capacity of 450,000 pounds of steam per hour each and operate at 1425 pounds pressure and 900 degrees total steam temperature.

Throughout the country, Riley Steam Generating Units are giving such good account of themselves, that when additional boilers are required, in many cases Riley units are purchased without competition. What better assurance can be provided that you can rely on Riley, than the fact that users invariably come back for more Riley units. Because of the regularity with which Riley units exceed guaranteed efficiencies and capacity, you are assured that when you purchase Riley equipment you will get more than your money's worth—many plus values that pay real dividends.



A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

before purchasing Boiler or Fuel Burning Equipment

Here Are Methods to Keep Good Oil Good

(*Continued from page* 95)

Program for Lubricant Storage and Handling

Returning to the problem of handling our lubricants, we used the organization chart outlined in Fig. 2 to set up the following lubricant storage and handling program:

Delivery. All oils are delivered in refinery-sealed 55-gal drums and all grease in 100-lb refinery-packed and sealed drums.

Receiving. All lubricants are received from the vendor through the regular stockroom. Routine handling procedure is used except that stockroom clerks do not break seals.

Bulk storage. (1) Large accessible bulk storage room is provided in a convenient location. This room is locked and only the members of the lubrication staff have access to it. (2) Factory seals are not broken until containers are transferred to the storage area. (3) Samples of oil and greases are taken by an instructed member of the lubrication department and sent to the control laboratory for analysis.

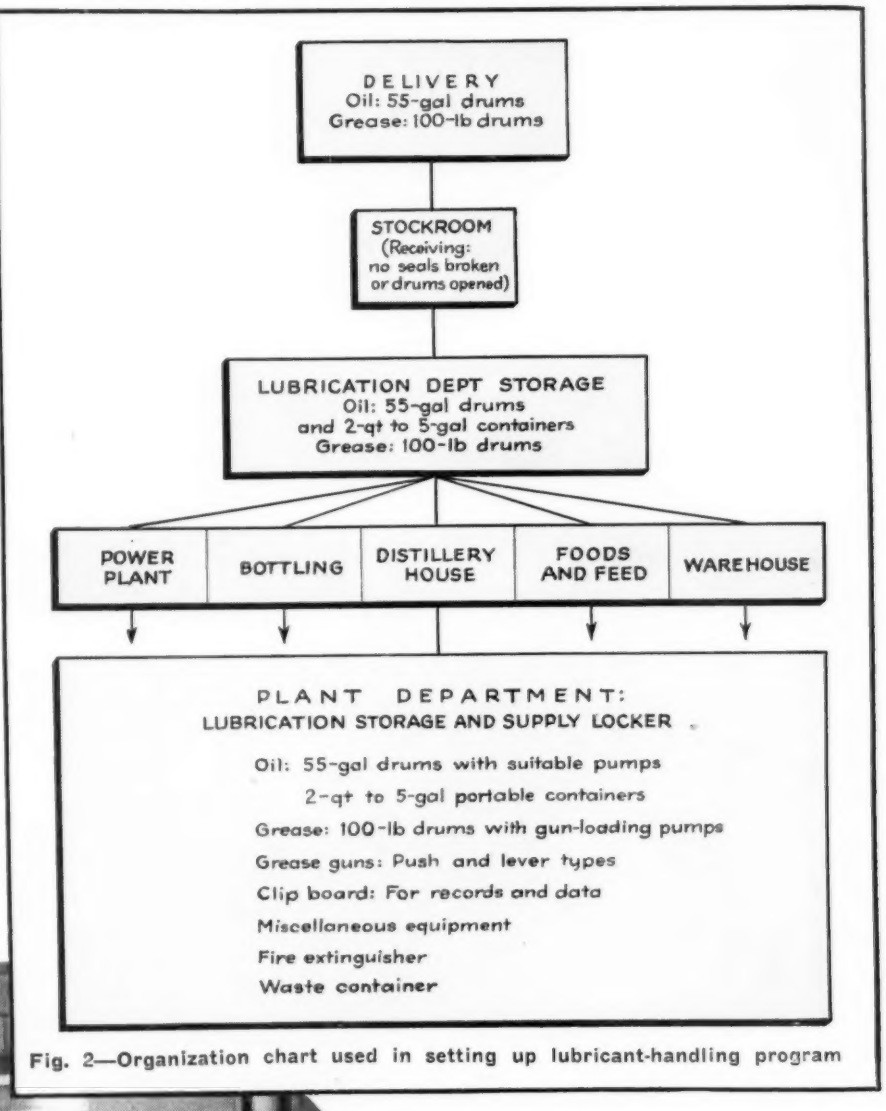


Fig. 2—Organization chart used in setting up lubricant-handling program

Transfer. (1) Oils are withdrawn direct from the drums by a suitable pump which returns the drippings through spring-return drain lines, Fig. 1. (2) Oil is pumped directly into 2-qt or 5-gal safety containers with spring-closed lids. Fig. 3. These containers are clearly labeled showing their use and contents. (3) Grease is distributed from the storage area in the original unopened drums.

Current storage. (1) Each depart-

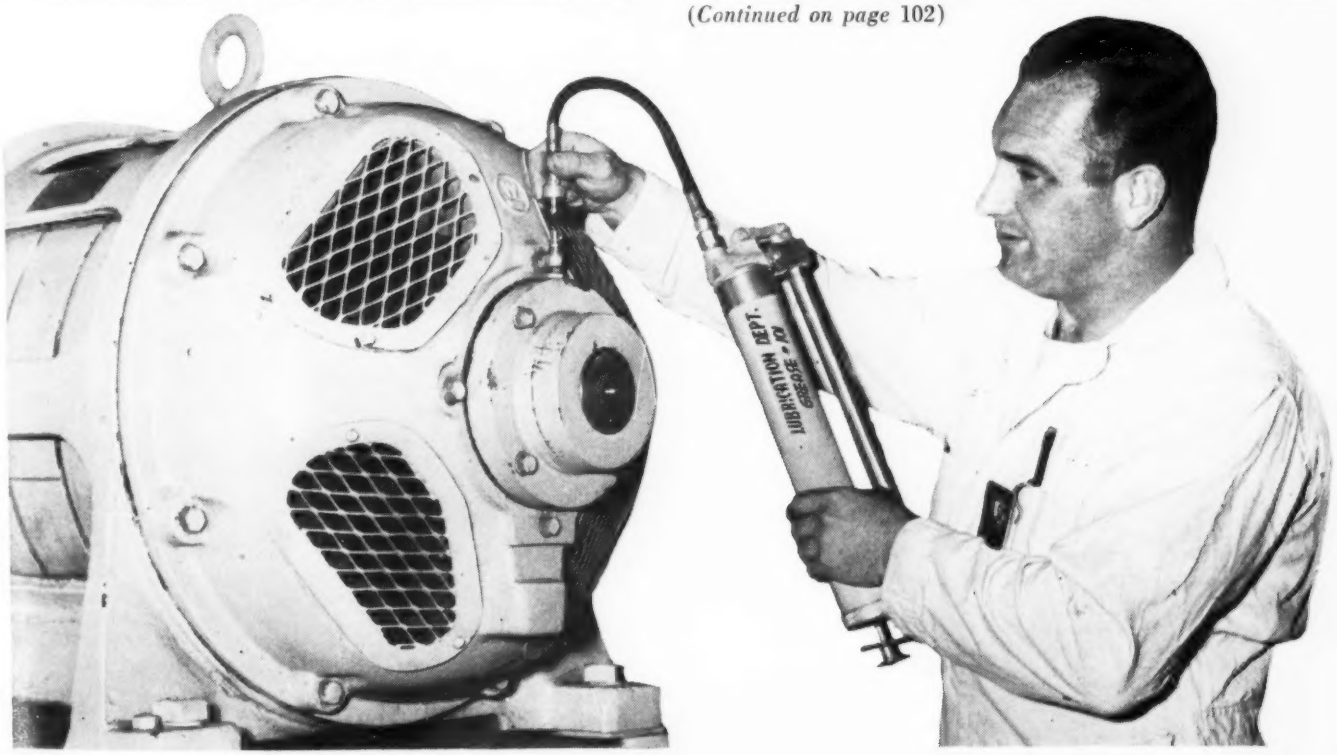
(*Continued on page* 102)

Fig. 3—Each departmental area is provided with a double-door steel lubrication locker. In it are stored complete supplies and lubricating equipment for efficiently servicing machinery in that area. Waste can and fire extinguisher are located nearby

Fig. 4—Correct lubrication is insured by adopting different types of fittings such as pin, hydraulic, dot and button head. These fittings are installed on the various machines and match the guns, thus indicating the grease to be used in each case. Fig. 5 (right)—Grease guns are equipped with special fittings, which are mated with the loading pump.

This procedure not only protects the lubricant during the loading process and insures loading the gun with the correct grease but also provides a clean and efficient method of handling. Fig. 6 (below)—The positive connection and flexible hose on this gun make it convenient to use where high pressure is needed in isolated locations in the plant

(*Continued on page* 102)



HOW TO TRAP...

for quick, thorough condensate drainage

STEAM HEADERS

Tips on trapping steam headers...

- For long supply mains, install traps at intervals of from 300 to 800 feet.
- Regardless of interval, install traps at all natural drainage points.
- Provide drip pockets or tack weld a dam in the pipe to insure the condensate's reaching the trap.

TABLE A. THE WARMING-UP LOAD

Showing the total steam condensed in raising ordinary wrought iron pipe from 70° F room temperature to saturated steam temperature for various pressures.

Steam Pressure lbs.□"	2.3	5.3	10.3	25.3	50.3	100.3	150.3	200.3	250.3
Steam Temperature °F	219.4	228.0	240.1	267.3	298.0	338.1	366.0	388.0	406.2
Temperature Rise from 70° F	149.4	158.0	170.1	197.3	228.0	268.1	296.0	318.0	336.2
Latent Heat	965.6	960.0	952.0	933.3	911.0	879.8	856.8	837.9	821.6

Pipe Size	Wt. of Pipe per Foot	Pounds of Water per Linear Foot							
1"	1.7 lbs.	.0295	.0314	.0342	.0404	.0477	.0583	.0660	.0725	.078
1¼	2.3	.0400	.0426	.0463	.0548	.0647	.0791	.0895	.0983	106
1½	2.7	.0478	.0509	.0553	.0655	.0773	.0944	1070	1174	127
2	3.65	.0643	.0687	.0745	.0883	104	127	144	158	170
2½	5.8	102	109	118	133	.165	.202	.232	250	270
3	7.6	133	143	155	183	.217	.264	.299	328	.354
3½	9.2	.161	173	188	222	264	320	.362	.397	429
4	10.9	.192	.205	222	.263	311	.378	429	.472	.509
5	14.8	.261	.278	.302	358	.423	514	.582	641	690
6	19.2	.338	.362	392	464	.549	666	755	.829	.895
7	23.8	418	448	485	.575	.680	.826	.937	1.030	1.109
8	28.8	.507	.542	589	696	.822	1.002	1.135	1.248	1.344
9	34.1	.600	.642	696	825	976	1.185	1.343	1.478	1.591
10	40.5	712	761	.827	.978	1.156	1 408	1.593	1.752	1.890
11	45.6	.803	.858	.931	1.102	1.304	1.588	1.795	1.973	2.125
12	49.6	.871	.932	1.011	1.197	1.420	1.722	1.953	2.146	2.312
13	54.6	.960	1.029	1 116	1.321	1.560	1.899	2.150	2.362	2.542
14	58.6	1.031	1.102	1.196	1.416	1.674	2.035	2.310	2.535	2.730
15	62.6	1.103	1.179	1.280	1.513	1.792	2.175	2.465	2.715	2.920

TABLE B. THE NORMAL RADIATION LOAD

Showing the rate of condensation in bare pipe carrying saturated steam at various pressures in quiet air at 75° F

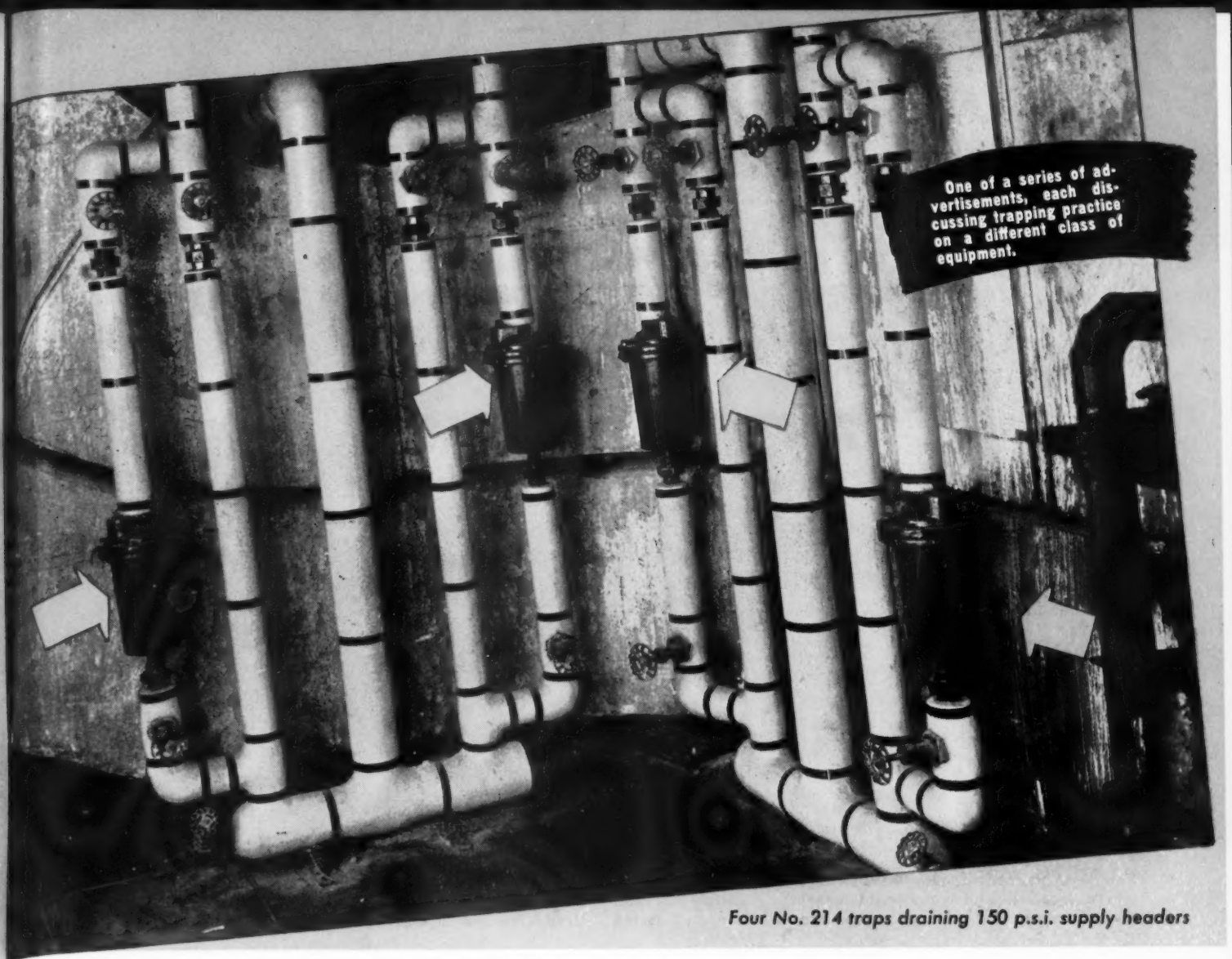
Pressure, lbs. gauge	2.3	5.3	10.3	25.3	50.3	100.3	150.3	200.3	250.3
Steam Temp. °F	219.4	228.0	240.1	267.3	298.0	338.1	366.0	388.0	406.2
Temp. Rise from 75° F	144.4	153.0	165.1	192.3	223.0	263.1	291.0	313.0	331.2
Latent Heat of Steam	965.6	960.0	952.0	933.3	911.0	879.8	856.8	837.9	821.6

Pipe Size in Inches	Length per Sq. Ft. of Radiation	Pounds of Water per Hour per Linear Foot								
1	2.904'		.16	18	.22	.28	.36	43	.49	.55
1¼	2.301'	14	19	.22	.26	.34	.44	.53	.60	.67
1½	2.01'	.17	.21	.24	.31	.38	.50	.60	.68	76
2	1.608'	.19	.25	.28	.36	.45	59	71	.81	.92
2½	1.328'	.23	.30	.34	.43	.54	70	.84	.97	1.09
3	1.091'	.27	.36	.40	.51	.64	.84	1.00	1.15	1.30
4	.848'	.33	.45	.51	.64	.80	1.06	1.27	1.47	1.64
5	.686'		.55	.62	78	.97	1.29	1.55	1.78	1.99
6	.576'		.64	72	.91	1.14	1.52	1.85	2.09	2.34
7	.500'		.74	.82	1.03	1.30	1.73	2.07	2.39	2.68
8	.442'		.82	.92	1.15	1.46	1.94	2.33	2.68	3.01
9	.396'		.91	1.02	1.27	1.62	2.15	2.59	2.98	3.35
10	.355'		1.01	1.13	1.42	1.80	2.39	2.88	3.30	3.71
11	.325'		1.10	1.23	1.55	1.96	2.60	3.13	3.60	4.04
12	.299'		1.20	1.34	1.68	2.13	2.81	3.40	3.91	4.39
Large Pipe or Flat Surfaces per Sq. Ft.			.34	.37	.49	.64	.83	.99	1.14	1.28

Forged Steel Traps for pressures to 2400 lbs.

Side-inlet, side-outlet medium pressure traps.

Bottom-inlet, top-outlet medium pressure traps



Four No. 214 traps draining 150 p.s.i. supply headers

Armstrong traps provide thorough, quick, efficient drainage of steam headers because they fulfill these fundamental requirements:

1. Handling of condensate formed when the steam is turned on (Table A).

2. Discharging condensate formed by unavoidable radiation loss from the steam header (Table B).

3. Discharging prime carried over from the boiler.

For the right size trap for the job, check with Armstrong. Capacities from 450 to 300,000 lbs. per hr. You'll find Armstrong traps will give complete satisfaction in every respect. Over a million installations have proved their ability to:

- Discharge all condensate with no steam loss.
- Operate perfectly with ordinary amounts of dirt and foreign matter.
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ARMSTRONG *Inverted Bucket* STEAM TRAPS

Over a Million in Use... For Power... Process... Heating

Here Are Methods to Keep Good Oil Good

(*Continued from page 99*)

Fig. 7—This centralized lubrication system was installed where location and number of bearings justified its use. Predetermined amounts of grease are fed to each bearing

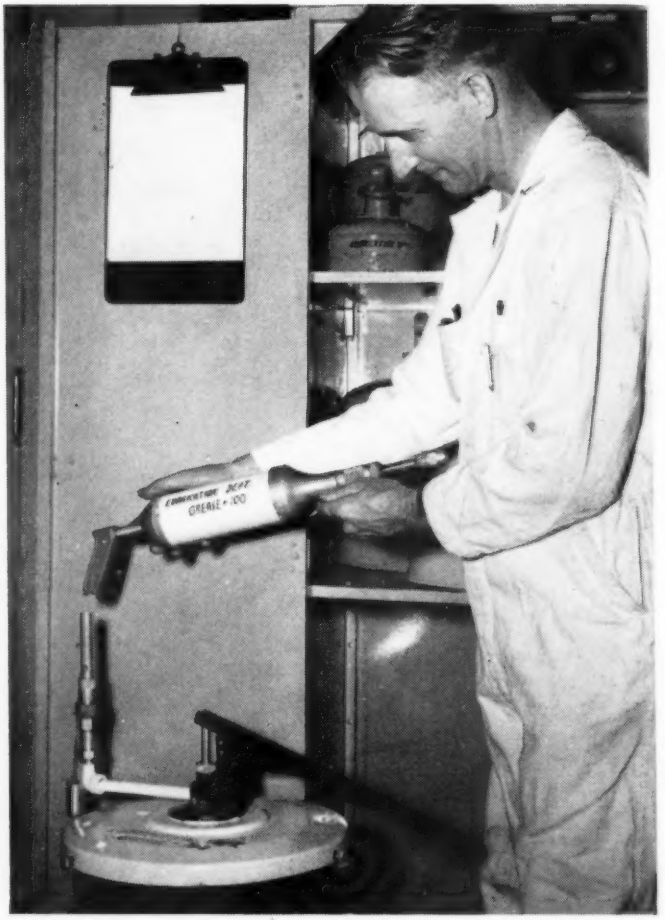


Fig. 8—Special fittings for loading push-type grease guns through the handle make a handy gun that is easy to fill. Grease to use is marked on the barrel for easy reference

mental area, such as power plant, bottling, distillery, foods and warehouse, is provided with a lubrication locker. It is a double-door steel cabinet with slanting top to eliminate outside storage. In each locker are stored the complete supplies and lubricating equipment for efficiently servicing the units in the area. Fig. 3. (2) Alongside each locker are a metal container for storing dirty wiping cloths and a neat-looking bin for clean rags. (3) A fire extinguisher is conspicuously hung near each lubrication locker. (4) All grease drums have loader pumps to pump the greases directly into grease guns.

Application. (1) To insure correct lubrication different types of fittings such as pin, hydraulic, dot, button head were installed for each of the different greases. Fig. 4 and 6. A similar arrangement was used on loader pumps and loading ends of the grease guns. Fig. 5 and 8. This system has made our lubrication practically foolproof. (2) Where the number and location of bearings warranted it, we adopted a centralized lubrication system. It feeds predetermined amounts of lubricant to each bearing and is automatic or hand operated, Fig. 7.

These systems are made to lubricate one or a hundred bearings, which may be stationary, reciprocating or rotating, closely spaced on one machine or spread throughout an entire plant. Centralized lubricating systems of this kind cover many conditions and save much time and money. To insure filling the centralized reservoirs with proper lubricants, either a colored route system, or mated fittings, or both, are effective.

Where the number of lubricants is not too great, a practical scheme for preventing mistakes in their application is the adoption of any one of the colored routing lubrication programs available. In general, these systems consist of labeling each drum, oil can, grease can, and grease gun, with a colored decal transfer or other method, selecting a different color for each brand of lubricant. All oil cups and grease fittings are correspondingly labeled by colored decals or plastic disks of various colors and shapes. Each color designates the particular brand of lubricant and the shape (circular, square, hexagonal) designates the period of lubrication (once per shift, once per day, once per week).

Advantages. The results of any systematic storage-and-handling program is better lubrication and less maintenance of equipment. These advantages, however, did not become evident in our system until it had been in operation long enough to collect sufficient data to prove its effect. Immediate results were observed in costs and appearance from these main factors: (1) Handling and storing costs were lowered by systematic cost accounting. (2) Control of lubrication became effective under centralized supervision. (3) Safety regulations were easily enforced and observed in our controlled organization. (4) Lubrication by each member of the staff was clean and effective.

We believe that in any plant a similar system will show a decrease in lubrication and maintenance costs and an increase in performance from the machinery. Our system would naturally be modified to suit individual requirements but the principle would remain the same.

INCENTIVES FURNISH THE DRIVE

THE COMING YEAR, 1946, and the years to follow can bring unprecedented prosperity to the people of the United States if the incentives to secure it are provided.

We have the advantage of starting with an economy which has demonstrated a capacity for expansion unequalled in any other country in the world. Our economy has demonstrated, also, one grave weakness—a recurring interruption of the upward trend of production and living standards by wasteful and paralyzing periods of recession. Recovery from each depression always has carried us to new heights of economic welfare, but the toll of the years of blight has been harmful to everyone.

The job ahead of us is a dual one. We must maintain the vitality of an economy which, over the years, has yielded an enormous increase in the American standard of living, and we also must improve its stability.

The Dynamics of American Production

In the last prewar year, 1940, the population of the United States was 3⅓ times as large as it was in 1870. But the national production, measured in dollars of constant purchasing power, was 10 times as large at the end of the period, and industrial output had increased 20-fold.

In the meantime, the average number of hours of factory workers had been reduced from about 63 per week in 1870 to less than 40 in 1940, while average hourly earnings had more than trebled in dollars of constant purchasing power. Thus "real" weekly or annual wages in manufacturing had doubled over the 70-year period, even though the work-week was cut by 35 per cent. This was made possible chiefly by a tremendous increase in the quantity and quality of the mechanical facilities which were provided in American manufacturing industry. Manufacturing capital investment per worker was multiplied by 6 times over the period in question. But the return per dollar invested, while it has fluctuated widely between good years and bad, showed no general upward trend over that portion of the period for which measurement is practicable.

Incentives in American Manufacturing

There has been, historically, a remarkably consistent pattern in the division of the realized income from the expanding manufacturing output of America. Reliable statistics are not available for as far back as 1870, but from 1899 through 1939 the average share of wages and salaries has been 82½ per cent against 17½ per cent as the share to investors (including dividends, interest, rents, royalties, and non-corporate profits). There have been, from year to year, relatively minor divergences from this pattern of distribution, but there is no discernible trend during the period away from the averages cited.

It is suggested that the persistence of the average 17½ per cent share of realized income from manufacturing that was maintained for the 40 years preceding World War II may represent the proportion that is needed to produce the dividends, interest, rents, royalties, and non-corporate return that will provide for the continuing investment upon which an expanding productivity such as we have had in the past depends. At any rate, it would seem reckless to depart too radically from such an established pattern at a time when unprecedentedly large private capital investment is counted on to make up for the drastic curtailment of such investment during the war years, and to carry us to the new high levels of civilian production set as our postwar goals.

The Distribution of Manufacturing Income in War

At the beginning of the war, the Government adopted controls and a tax program designed to prevent wartime activity from resulting in un-

duly swollen private returns. Due primarily to huge volumes, the profits *before* taxes of manufacturing industry were very high, but throughout the war its profits *after* taxes averaged returns no larger than they had been in good prewar years. Relative to volume, they were considerably lower than in prosperous years in the past. Again, there can be no complaint at results that generally were in accord with a national wartime policy.

But it is fair to note that the wages of manufacturing labor were allowed to increase substantially during the war. Between January 1, 1941 and April, 1945, average weekly earnings per worker increased by 77 per cent. This was, in considerable part, a result of increased working hours and a shift from low- to high-paid industries, but straight-time hourly earnings on the same jobs increased about 40 per cent against a cost-of-living rise of about 30 per cent.

The net result was to alter drastically the 40-year relationship of the 17½-82½ per cent division of Realized Income from Manufacturing. The share of wages and salaries increased to over 90 per cent, and the investment share shrunk to less than 10 per cent.

Its Postwar Distribution

This wartime shift in the proportion of distributive shares has an important bearing upon current wage controveries. With union demands for wage increases ranging up to 30 per cent, and the economists of the Office of War Mobilization and Reconversion asserting that an average increase of 24 per cent is feasible without raising prices, it is pertinent to inquire how such increases would affect the prewar ratios that governed realized income distribution in manufacturing.

Forecasting is always hazardous, but if we assume (1) that in 1946 we shall reach the $160 billion level of national output which the Government proponents of general wage increases expect, and (2) that there will be little increase in productivity because of the continuing process of reconversion, and (3) that the Government will succeed in carrying its announced purpose to maintain present price ceilings, it appears that a 24 per cent general wage increase would reduce the share going to capital from 17½ per cent to 11 per cent even allowing for its increased return resulting from the repeal of the excess profits tax. The prewar ratios would be about maintained if wages remained at present levels.

Conclusion

Since the maintenance of these prewar ratios was accompanied by an unparalleled rise in the "real wage" of American workers, there is a powerful prima facie case for not tinkering with them. It should be noted, however, that some economists think that the size of the investment share of manufacturing income tends to provide more capital than can be absorbed by a mature economy, and thus contributes to those breaks in the expansion of the economy which, as stated at the outset, have been its principal blight.

Regardless of what may ultimately prove to be the validity of this view, no one can responsibly contend that at this early but crucial stage in the reconversion process is the time to test it. Now, no one knows whether, or what dimension of, additional wage increases can be supported without forcing up prices or reducing profits to a point that will discourage vitally needed private capital investment.

We want high and increasing wages in American manufacturing. We need them to provide an active incentive to workers to support expanding productivity, as well as to continue the trend of rising living standards in America. Equally, we need a continuing profit incentive of sufficient attractiveness to call forth the new investment upon which expanding productivity depends.

We can never attain our dual objective if we push one of these aims so far and so fast that it defeats the other.

President, McGraw-Hill Publishing Co., Inc.

Closed-Cycle Gas Turbine Looks to Further Development

Theory, heat balance, governing and constructional features of closed-cycle gas turbine are described in abstract of paper, ASME 1945 meeting, New York, by Dr C Keller, director, research and development, Escher Wyss Engrg Works, Switzerland

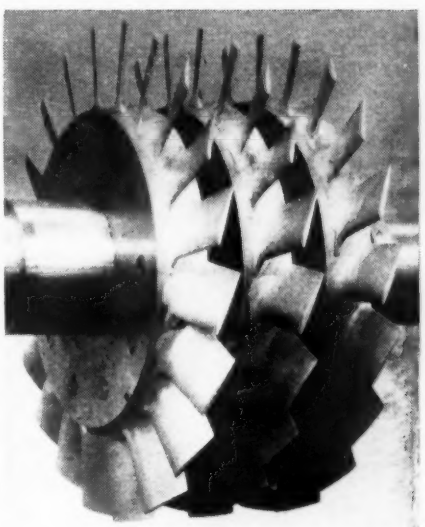


Fig. 2 (above)—Assembling blades on 32-in. diameter disk of h-p turbine for 12,000-kw 2-stage installation. Fig. 3 (below)—Modern axial-flow compressor impeller runs at above 90% efficiency

▶ COMPARISON OF THE ELEMENTS in the open-cycle and the Ackeret-Keller closed-cycle gas turbines is made in Fig. 1. Principal differences lie in furnace design and the use of a precooler in the closed system. In addition there is the supercharged air in the closed system, air pressure at the compressor suction being higher than atmospheric.

Advantages of the closed air circuit are (1) elimination of fouling of turbine blading and heat transfer surfaces by flyash (2) small-diameter tubing for heat exchangers possible with clean air (3) high air pressures reducing dimensions of turbines, compressors and heat exchangers because of smaller air specific volume and higher heat-transfer coefficients (4) burning of any type of fuel.

Plant output is controlled by adding air to or taking it from the circuit without changing temperatures, and results in only slight change in efficiency. By changing the pressure level, only the density of the air varies; practically unaltered are flow conditions, pressure ratios, velocities, air entrance angles relative to the blades and engine efficiency. Furthermore the machines always operate at the same point on their pressure-volume characteristics, resulting in plant thermal efficiency being almost equally as high at part as at full load.

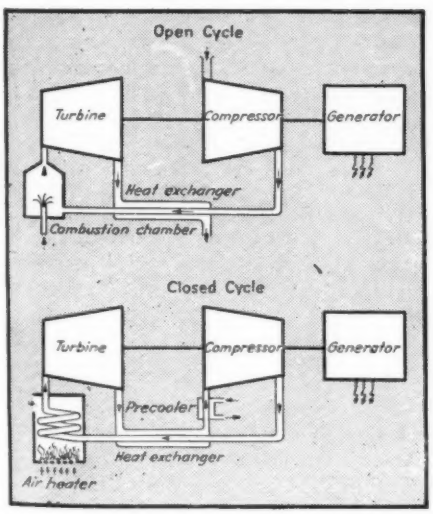


Fig. 1—Arrangement of open-cycle and closed-cycle gas-turbine elements. Combustion products pass through open-cycle turbine but not through closed-cycle

Constant temperatures are of great practical advantage. The circuit proper has no regulating valves. Control of air admission and withdrawal from the circuit is effected by a regulating set outside the working circuit that handles only cold air. Air is stored cold in compressed-air accumulators.

For a simple experimental plant of 2000-kw capacity operating at Zurich. Switzerland (POWER, Aug 1945, pp 80-81) optimum pressure ratio is about 3 to 4 with maximum pressures of 400 to 500 psia depending upon the output. Efficiency being independent of pressure level, the pressures are chosen with regard to constructional requirements only.

For initial temperatures of 1200 to 1400 F, discharge temperatures at the turbine are not higher than 750 to 950 F; hence no special alloyed steels are needed for heat exchangers. Because of its experimental nature, this initial installation should not be taken as a criterion of arrangement and space requirements of commercial units.

Designs for commercial installations include 2-stage heating and expansion, which cause a 10 to 15% fuel saving and make feasible a pressure ratio of about 10. In turn this allows further reductions in physical dimensions. Fig. 5 shows the energy-stream diagram for this design.

Maximum pressures of 400 to 600 psia with backpressures of 40 to 60 psia will be used for small outputs; for outputs above 10,000 kw the pressure will reach 850 psia with 85-psia backpressure. Heat drops will be arranged to avoid use of special alloyed steels in the heat exchangers. These designs are suitable for standardization; capacities ranging from 3000 to 50,000 kw can be built from a few types and sizes of machines, heat exchangers and regulators.

Absence of stop and regulating valves in the working circuit aids in keeping

turbine inlet and outlet losses at a minimum. This is important because of the small pressure and temperature drops utilized. The turbine is literally situated in the piping of the circuit (POWER, Nov 1945, pp 66-67).

Double-casing construction can be applied to the turbines because of their small size. Between the thin internal shell and the external casing there is a layer of insulating material. The internal shell holding the blading conducts the hot air while the cold external shell takes up the pressure. The arrangement is fixed to the casing at a point where temperatures are low. Even for high inlet temperatures the external shell is subject at most to a discharge temperature of about 925 F. Hence high heat-resisting steels are not required for the casing but only for the internal parts.

Modern axial-flow multistage compressors are particularly suited for handling large air quantities through small pressure increase. The high speeds required are advantageous for both turbine and compressor design and aid in keeping compressor dimensions relatively small. Compressor blading, as in Fig. 3, is operating at efficiencies greater than obtained for radial compressors.

As turbine and compressor work at the same operating point at all loads, blading need be designed for only this point without compromise. As a result of the higher pressures the Reynolds numbers of the machine bladings are of a high order and the proportion of friction losses becomes smaller. Laboratory tests have shown that axial compressors when working on air contaminated with usual workshop impurities have dropped in efficiency from 86 to 83% over a 12-hour period.

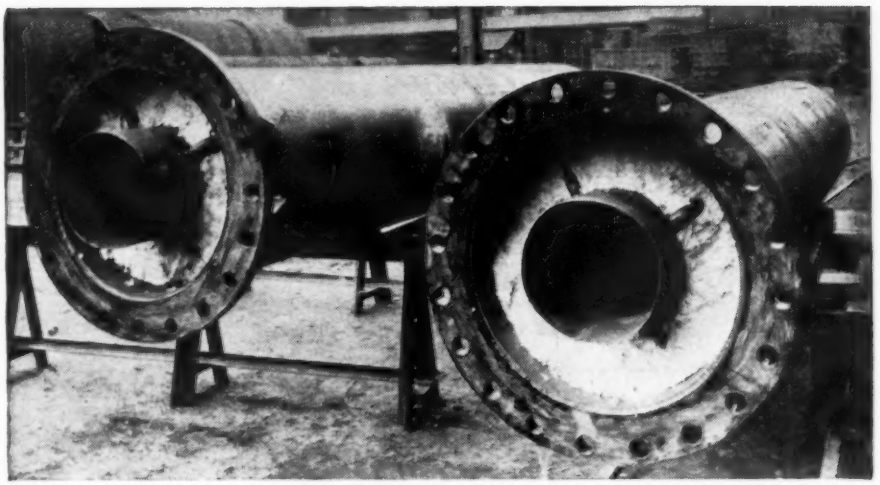


Fig. 4—Double-shell piping construction for high-pressure hot air, inner tube of high-temperature metal conducts gas; outer tube is pressure-resisting member and built of lower-quality steel. Ports in inner tube connect to annular space

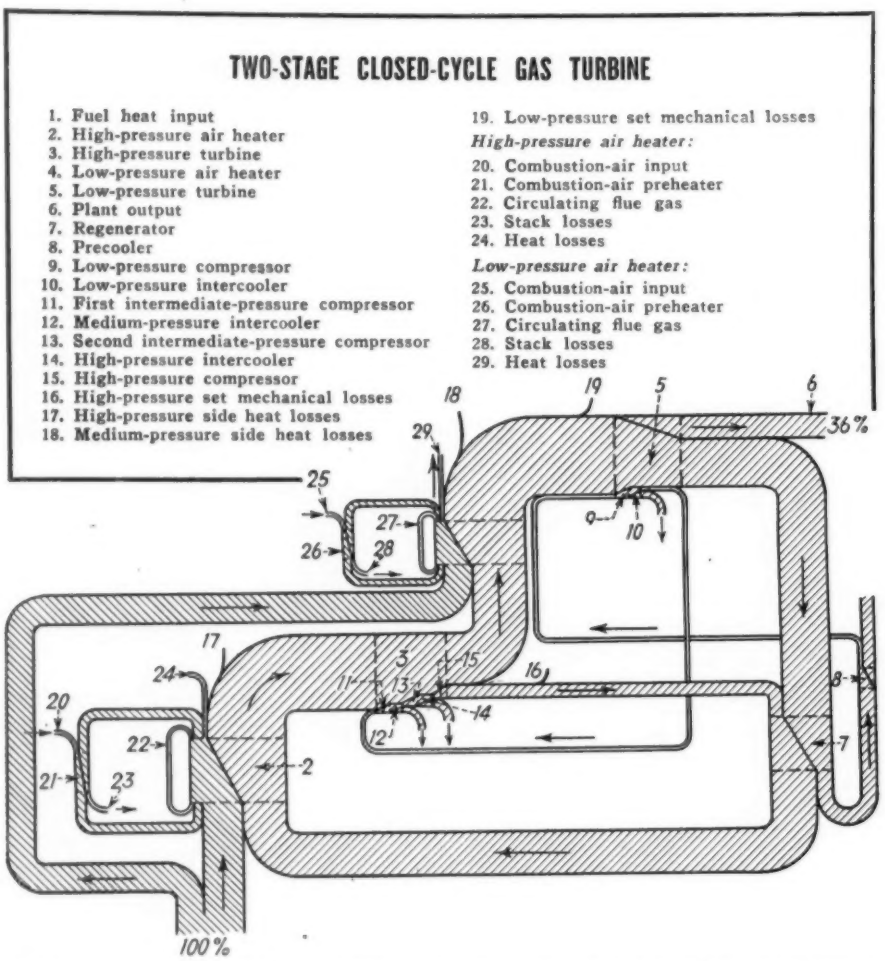


Fig. 5—Energy stream diagram for 2-stage closed-cycle gas turbine. Fuel energy 1; distributed as output 6; precooler rejected energy 8; air-heater losses 23, 24, 28, 29; mechanical and heat losses listed in table; rejected energy in low-, medium-, high-pressure intercoolers, 10, 12, 14. Gas circuit: 8-5-3-7-2-3-4-5-7-8

Fig. 6 shows the type of sealing gland in the experimental plant. Sealing air extracted from the circuit is led to the labyrinth chambers. Sealing-air pressure is always higher than air in the turbine regardless of load. At the point where sealing air enters, a part branches off towards the gland exterior and flows into a collecting space, which is connected to a point in the circuit where a lower pressure always prevails. Placed outside the air-sealed gland is a ring through which oil under pressure is supplied to the shaft. This pressure oil prevents air escape from the circuit. The sealing air also serves to cool the turbine shaft ends so that the bearing sections remain quite cold.

Double-walled piping utilized throughout the high-temperature part of the circuit consists of a thin-walled internal tube of heat-resisting material separated from a thicker-walled pipe of standard material by a layer of insulation, Fig. 4. Thin inner tube is relieved of pressure by ports leading into the insulated space; the outer wall resisting the air pressure is not subject to high temperature.

In the closed-cycle circuit the air heater is the counterpart of the boiler in a steam-plant circuit. Air-heater design depends on the fuel burned. Coal-fired heaters

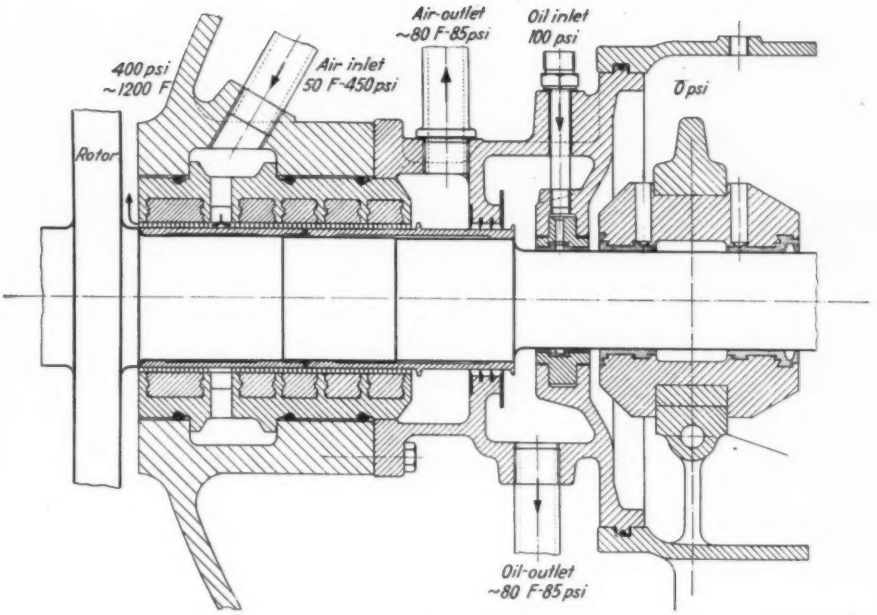
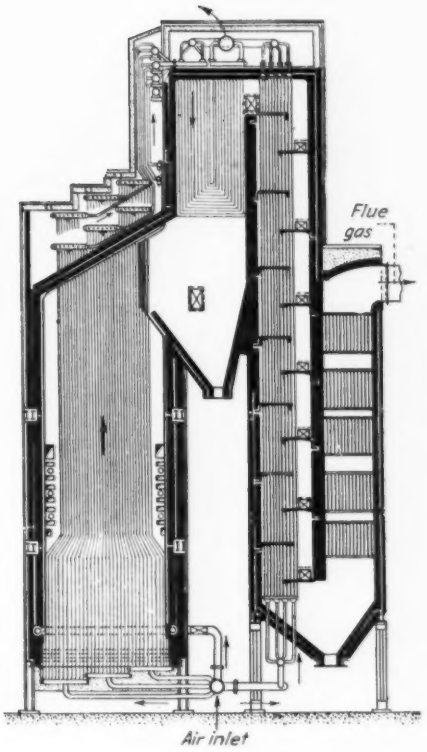


Fig. 6—Turbine gland is a combined labyrinth-fluid sealing arrangement. High-pressure low-temperature air bled from circuit flows into the labyrinth and along the shaft and then to low-pressure circuit point. Oil seal prevents air leakage



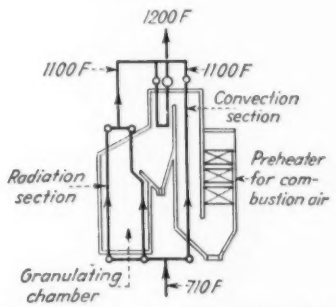


Fig. 7—Air heater using pulverized coal firing. Small diagram shows arrangement of air circuits through heater. Air-pressure drop is less than 5%

resemble modern high-pressure steam boilers in appearance, as in Fig. 7. Space requirements compared to the steam boiler are not greater for air heaters. Since Fig. 7 is an initial installation for a 12,000-kw plant, design is conservative regarding both provisions for the furnace and tube temperatures and stresses. It is expected that subsequent developments will lead to smaller heater dimensions.

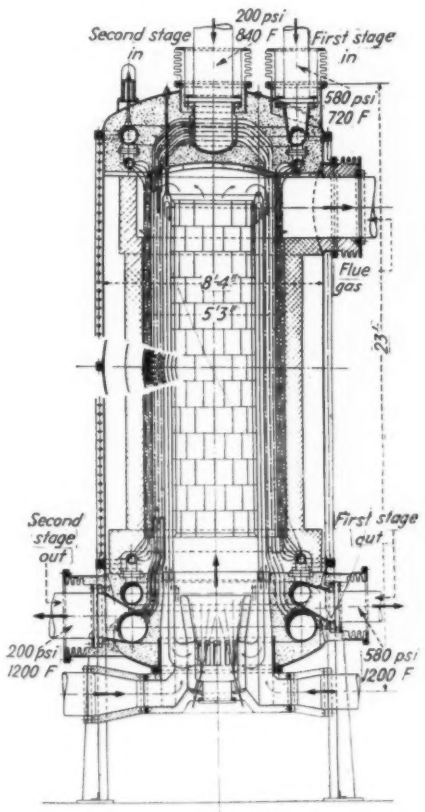


Fig. 8—Air heater for a 6000-kw unit with an oil-fired supercharged furnace

Tube-nest inlet temperature is about 1850 F. Returning flue gas to the combustion chamber regulates and reduces furnace-gas temperatures. Tube diameters are about ¾ to 1½ in. and wall thicknesses about 0.1 to 0.15 in.

Oil- and gas-fired heaters can be made more compact. Where space restrictions control, as in marine installations, it is possible to reduce heater dimensions (to about half surface) and weights by supercharging the combustion chamber.

Fig. 8 illustrates an oil-fired heater for a 2-stage 6000-kw plant operating at 600 psia. Tubes surround the supercharged combustion chamber.

The 600-psia first-stage and 200-psia second-stage tubes are arranged for heating by a common furnace. In this heater the furnace is lined with refractory material and heat conveyed mainly by convection. Heating surface can be kept small by raising combustion-gas pressure to about 45 to 70 psia, and maintaining combustion-gas velocities from 100 to 160 ft per sec, and tube-air velocities from 65 to 130 ft per sec. For such projects surface amounts to only ½ sq ft per kw net plant output. Total weight of iron in such an air heater is less than 9 lb per kw; of this amount 50% will be alloyed steels.

In operation the tubes can expand freely in the upward direction and may do so by about 2½ in. To keep hot-air piping as short as possible the heated air for the high- and low-pressure turbines is discharged below. Shell of heater is ordinary steel, made airtight. It can be dismantled in a number of sections so that the tubes, easily accessible from the side, are removed without difficulty. The shell also serves as a support for the tubes.

Since the exit flue gas is at about 1000 F it is expanded in an exhaust turbine and thereby cooled. This turbine drives the compressor for the combustion air and hence eliminates an air preheater. Air-heater design for burning blast-furnace or natural gas is largely similar to that for oil firing.

Air-heater design of Fig. 8 corresponds in principle to the one in the experimental plant with the exception that for simplicity furnace supercharging was not applied.

It is often assumed that a high velocity and considerable pressure drop are needed in the heater tubes to carry away the heat. For the air heater of a 400-psia plant the pressure drop is only about 10 to 15 psi, and for a 850-psia plant with two stages it totals 20 plus 30 psi.

Calculation of velocity and pressure-drop problems have led to a series of fundamental circulation layouts for the air to be heated and for the combustion gas. Tube-wall temperatures can be reduced by suitable layouts using counter flow, parallel flow and transverse flow in the various heater sections. Fig. 7 shows one of the many solutions that can be adopted. Air to be heated is divided at the inlet into two parallel circuits; one chiefly subjected to radiation runs as a parallel flow to the flue gas, the other as a counter flow. This brings about a gas-temperature reduction in the hottest sections. The division into several parallel currents helps reduce the total pressure loss. Only a part of the heater must be made of special high-quality materials. For the working pressures involved the tube-wall stresses are very small, about 2500 to 4000 lb per sq in.

Without a heat regenerator it is hardly possible to raise the thermal efficiency of any kind of gas-turbine cycle above 20%. In the supercharged closed cycle the heat-transmission coefficients on both sides of regenerator surfaces are raised considerably. In combination with the small specific volume this increase offers possibilities of greatly reducing both dimensions and weights. Furthermore, small surface elements can be used because of the elimination of fouling. Apart from the turbine and compressor high blading efficiency the realization of high heat transfers is one of the chief reasons for the high over-all efficiency of closed-cycle installations, even when employing moderate temperatures.

Design of the tubular regenerator given in Fig. 10 works on the counter-flow principle and transmits maximum heat with minimum pressure loss. High-pressure air flows through the tubes and the shell withstands the lower backpressure of the air. Normal tubes of small diameter permit standardization of all heat-exchanger elements for the various capacities.

Tubes of 0.15 to 0.25 in. diameter are spaced by distance pieces offering little resistance to air flow. A large number of these thin tubes are arranged in a tube nest. All nests, connected by a small number of collector pipes, may be separately removed; for the stationary plant in an axial direction; for the marine plant by providing a split shell for the exchanger.

With a temperature of about 200 to 250 F the air leaves the regenerator and enters the precooler before again entering the cycle at the compressor suction. Water is the cooling medium in the precooler; because of the higher heat-transfer rates with high-pressure air the precooler can be made smaller than for most atmospheric air-cooling applications.

Arrangement of governing-system elements in Fig. 9 applies to a simple single-stage plant. In responding to small load decreases some of the high-pressure air discharged from the compressor is short circuited to the compressor inlet through the bypass valve thereby decreasing turbine-energy input. For large load decreases the combined inlet-outlet valve operates to permit air from the high-pressure side of the compressor to flow to the low-pressure accumulator. This withdrawal of air from the circuit reduces the energy input to the plant and returns generator speed to normal.

When the load increases, the inlet-outlet valve admits air from the high-pressure accumulator to the circuit. Withdrawal and admission of air from and to the circuit have immediate effect on output because the pressure ratio of the cycle that is altered is one of the controlling factors.

Closed-cycle gas-turbine advantages compared to steam stations are (1) flexibility of equipment placement allowing very compact arrangements with minimum pressure and temperature losses (2) limited number of auxiliaries simplifying operating requirements (3) small cooling-water needs, being only 10 to 20% of steam-station requirements (4) absence of fittings for very high pressures. Taking into account these advantages, total costs of the two types of installations should not differ greatly.

Designs for 12,000- and 25,000-kw plants have been projected (POWER, Nov 1945, p 66). Such projects indicate that the length of plants is not greatly influenced by the capacity. Increase in capacity is achieved principally by enlarging the diameters of the equipment components.

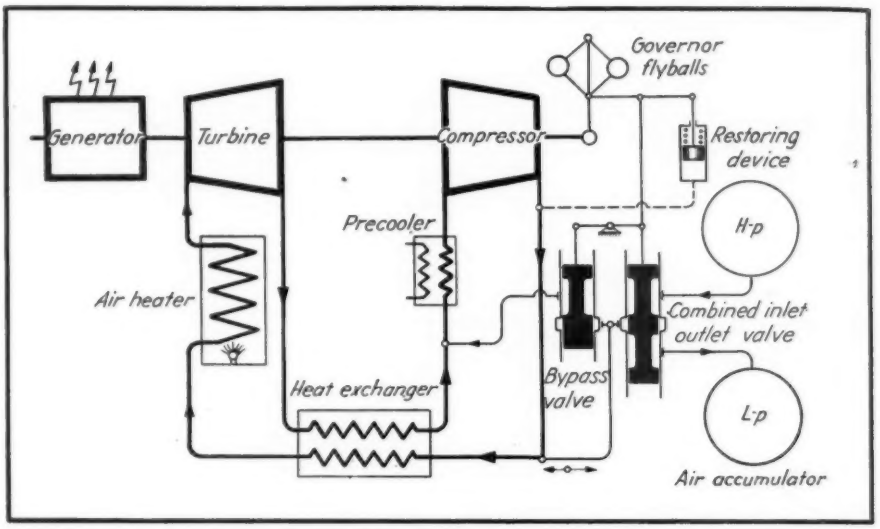


Fig. 9—Governing arrangement of single-shaft closed-cycle unit. For small drops in load bypass valve bleeds air from compressor outlet to inlet; for large load decreases, air is bled from closed circuit to l-p accumulator; for load increases air is admitted to closed circuit from h-p accumulator while turbine temperature remains substantially constant, rpm fluctuates about 2% during large load changes

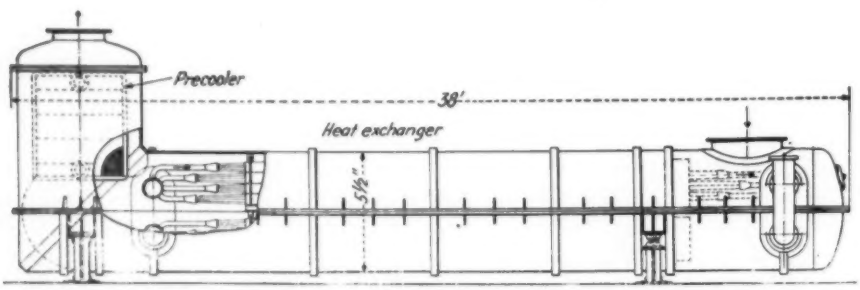


Fig. 10—Closed-cycle unit regenerator built up of small-diameter tubes has precooler incorporated in the same shell. High-pressure air flows through the tubes; while low-pressure air flows counter-current through shell and then the precooler

THE OPERATING ENGINEER

George Edwards *Advisory Editor*

PRACTICAL AIDS · MAINTENANCE HINTS · QUESTIONS — ANSWERS

PUBLISHED MONTHLY AS AN INTEGRAL PART OF POWER

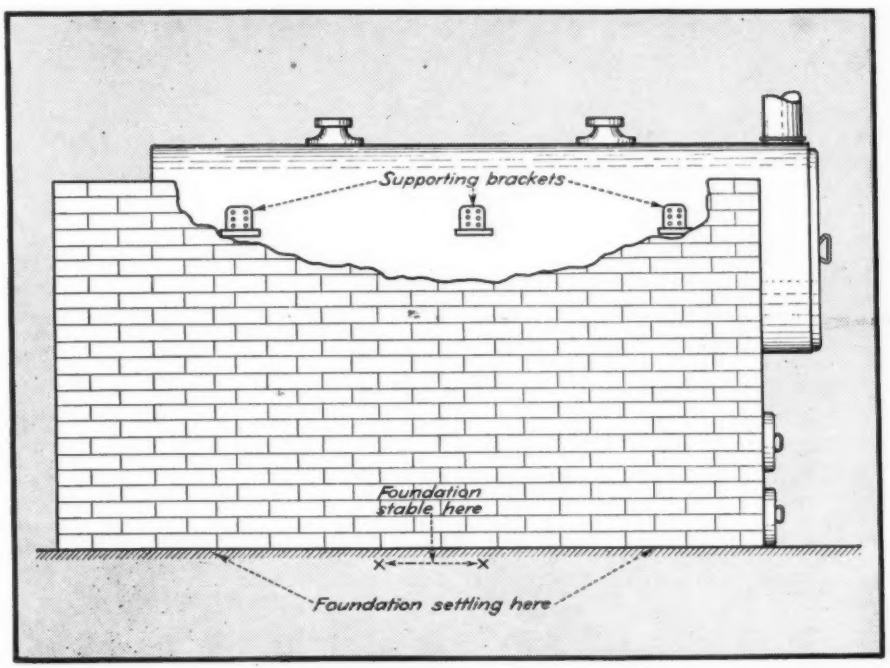
Inward Boiler Bulges Merit Practical Attention

Harry M Spring explains five most probable causes for these boiler defects. To recognize and prevent this trouble requires an understanding of how it occurs. Here are some on-the-job precautions that help to establish an alert inspection program

▶ MUCH HAS BEEN WRITTEN about why boiler shells bulge. Even though contributing factors are fairly numerous, the compelling force that actually causes the bulge is pressure, and the bulge is always away from the compelling force.

To this observer's knowledge, among literature on boiler bulges none has covered those bulging inwards. So with this in mind the following is advanced.

An inward bulge in a boiler shell is, to be sure, an unusual condition. By the same token it bespeaks an unusual cause. These causes though are limited in number and hence it should not be too difficult to determine the probable one when a boiler's history is investigated, a strong argument for keeping records.



Old style hrt-boiler-setting with side bracket support and brick foundation subjecting a boiler to severe stresses if foundation settles unevenly as shown here.

Inward deflection of boiler shells arises most likely from one of these five highly general causes: (1) unequal setting of supporting members (2) deformation in stress-relieving furnace (3) dry firing (4) dropping boiler at time of installation or otherwise (5) inexperience in driving back an external bulge.

Unequal setting: This condition is usually confined to a horizontal firetube boiler, fairly large in diameter. Furthermore it is usually found in an old type setting where the boiler rests on brick side walls with three brackets on each side of the boiler serving as supports.

With this form of construction, should the front and rear ends both settle because of an unstable foundation or other cause, severe stresses will develop at the center of the boiler. Under such heavy stress load, buckling of the shell may occur, and a crack develop at the girth joint. This is known as a "boiler breaking its back."

Regular Inspection Pays

If discovery of these distorting stresses is made before cracking begins, no repairs are necessary. Relief of these stresses, however, must be effected by resetting the boiler.

It is good practice, therefore, to examine the setting from time to time, keeping it in good repair. At the same time it is advisable to check the pitch of the boiler fore and aft, and to check against rolling due to settling of one side.

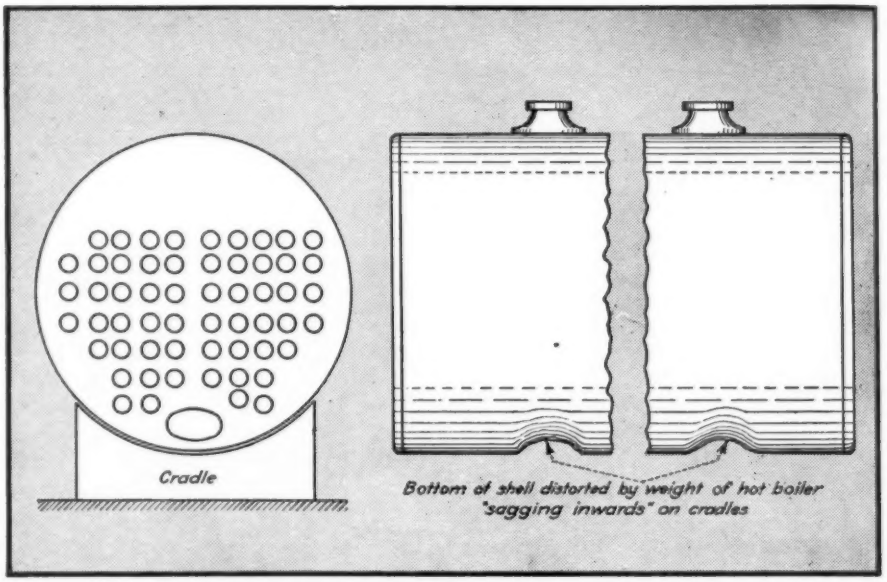
Deformation in stress-relieving furnace: Deformation in stress-relieving furnace develops only in a welded boiler. The ASME *Boiler Code* requires for welded boiler drums or shells: "Except as specifically provided otherwise in the Code, all fusion-welded pressure parts of

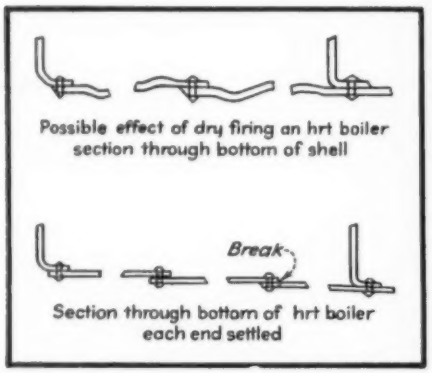
power boilers shall be stress relieved. It shall be done by heating uniformly to at least 1100 F, and up to 1200 F, or higher, if this can be done without distortion."

But this gives rise to the problem of just how high the temperature can go without distortion. Further, how would one know until distortion did begin? In brief, much remains to be answered.

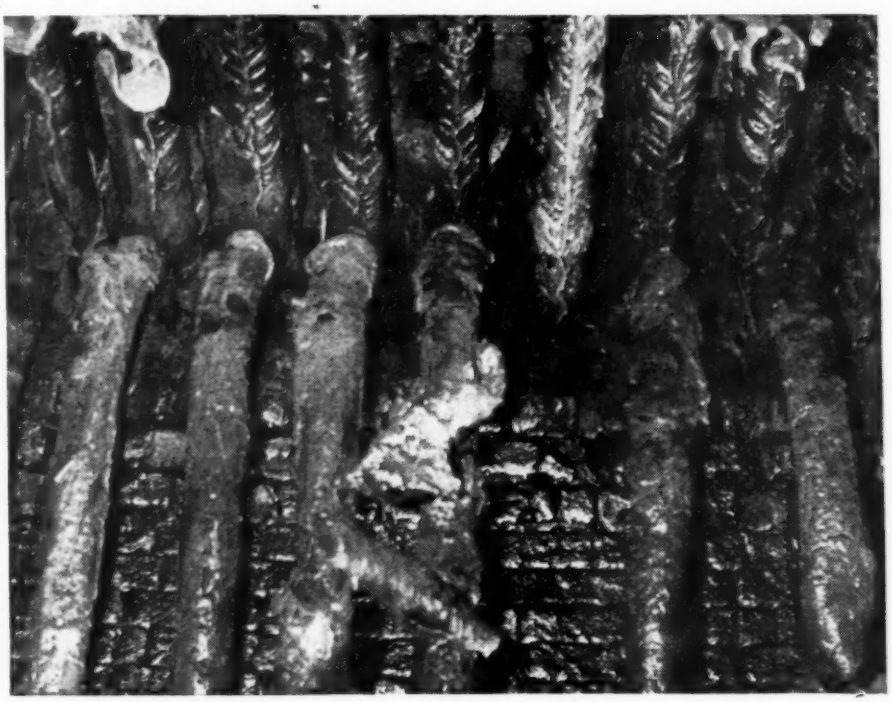
Slight distortion may very well develop and its presence not be detected until after the boiler is installed and in operation for as much as a year or more. Usually distortion appears, if at all, at the two points of support employed at the bottom of the shell when the unit was in the stress-relieving furnace.

It is well to point out that slight distortion may not seriously weaken the boiler. While harm from this condition seems unlikely no corrective action need be taken. If it is severe, however, a dam may form against which sludge accumulates. Then the boiler bulge should be heated and driven out.




Possible effect of dry firing an hrt boiler section through bottom of shell
Break
Section through bottom of hrt boiler each end settled

Two views of boiler shell that demonstrate damage from improper handling



Sectional view (top) of hrt boiler shows exaggerated inward bulges produced in a welded boiler while undergoing treatment in stress-relieving furnace. The photo (below) shows boiler tubing picturing actual results in a dry-fired unit. Heavy black oxide crust and fluid effect of melting heat indicate temperature attained

Dry firing: Accidentally, or otherwise, lighting a fire under a dry boiler is a sure way to damage it. In severe cases, the boiler may actually melt. If heating is less severe, the shell may bulge inwards, often in many places, leaving a rippled, mattresslike appearance. It would be difficult to duplicate this appearance in any other way.

Overheating just beyond the point of distortion but below the melting temperature will first cause discoloration, then oxidation of the plate with a typical black-oxide crust formation.

Dropping a boiler: Unfortunately boilers are dropped. This occurs sometimes when moving a unit or in erection. Sometimes those responsible try to hide the accident and say nothing, proceeding with the erection. Usually leakage under hydrostatic test reveals the condition.

An inward bulge appears at the point of contact with the damaging object. A bruised appearance at the deepest indentation testifies to the cause of the distortion of the boiler.

Inexperience in driving back a bulge: An outward bulge in a boiler shell forms a pocket in which deposits may lodge to cause further overheating and distortion. Minor bulges are best heated and set back with a striking hammer while major bulges require cutting out defective areas and repairing with a patch.

It calls for considerable skill to drive back a bulged plate to give a smooth-shell contour. A skilled boilermaker works from bulge's outside toward its center using techniques in several phases of his work that result from long experience. An inexperienced worker can so mishandle such a job that an irregular contour results. On occasion an inward depression, evident from hammer marks, indicates unskilled workmanship. Obviously a bulge should be set back only by able and experienced boilermakers. This precautionary measure may be classed as preventive maintenance.

Metalizing Gives Turbine New Lease on Life

Progressive erosion of the housing had become so bad that the unit would have had to be scrapped if the damage had not been repaired. Henry M Atwood, of Metallizing Co of America, tells how the eroded areas were built up with sprayed metal

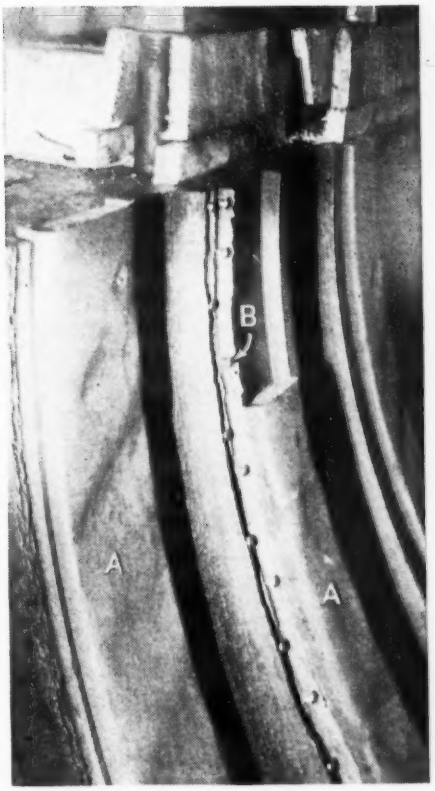


Fig. 1—Screws B, set in, strengthen builtup metal of the diaphragm rib

▶ Over a period of 23 years wet steam had eroded the housing and diaphragm ribs of a veteran turbine until it was no longer serviceable. A new machine could not be obtained at the time and the manufacturer suggested that metal spray be used to repair the damage.

Turbine design was such that the erosion did not affect machine efficiency; therefore it was not necessary to restore the areas to their original dimensions. In these areas and where strength of parts was not a factor a coating of 0.025 in. of 18-8 stainless steel was applied to arrest erosion. Temporary canvas covers, wood blocking and sheet rubber protected adjacent areas against grit blasting and metal spraying.

Wood inserts covered with sheet rubber, *A*, Fig. 1, protected the diaphragm channels. A frame work was erected around the inverted casing top to carry a tent of tarpaulins that would keep out of the surrounding machinery both the steel grit for cleaning and roughening the sections, and scale and dust blasted out of the housing. One small section at a time was blasted and the spray metal applied immediately. This prevented the cleaned surface from becoming contaminated by dust from other sections and eliminated any possibility of the prepared surface becoming oxidized during preparation of next section.

A rotating rest relieved the operator of the strain of holding the metalizing gun during the spraying process and also insured an absolute uniform thickness of coating on all treated surfaces. This rest was made by bolting an angle iron across the casing and welding a pipe bearing to it. A short-length shaft, inserted in the pipe, had a hole drilled through its diameter near the end for a rod, which was locked in position by a set screw. The rod carried a tool-post mounting on one end (to hold the spray gun) and a counterweight on the other.

Fig. 2 shows the completed upper half of the casing. The areas treated are easily distinguished by the light gray appearance of the stainless steel. After the machine has been in service for some time, steam action will automatically polish away the matte surface of the stainless steel and produce a bright, tough, noncorrosive surface that will resist attack for many years. Built-up rib may be clearly seen in the photo, which shows that a great proportion of the original area of this member has been restored.

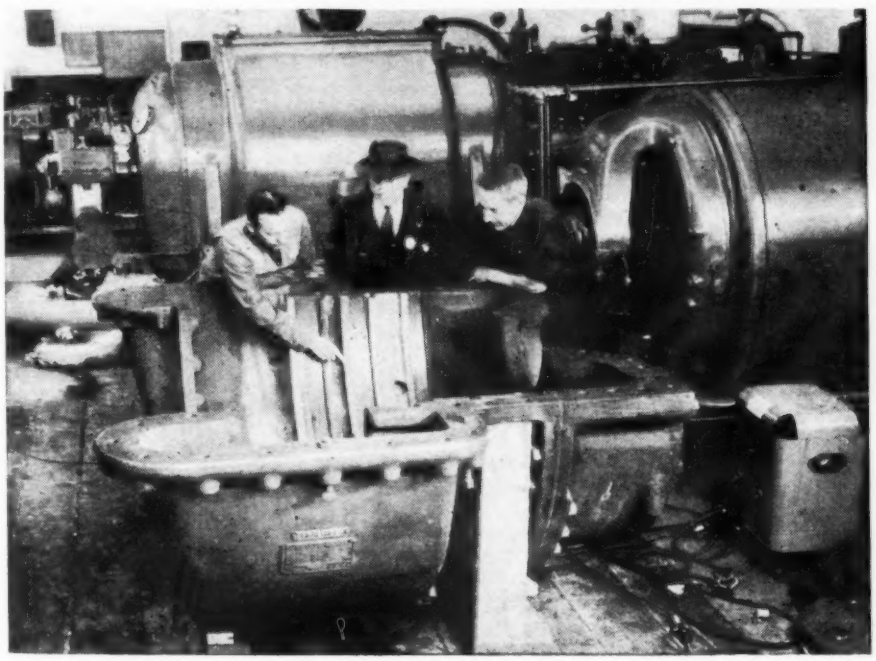


Fig. 2—The turbine casing was built up 0.025 in. with 18-8 stainless steel to arrest any further erosion. The original casing-wall dimensions were not restored

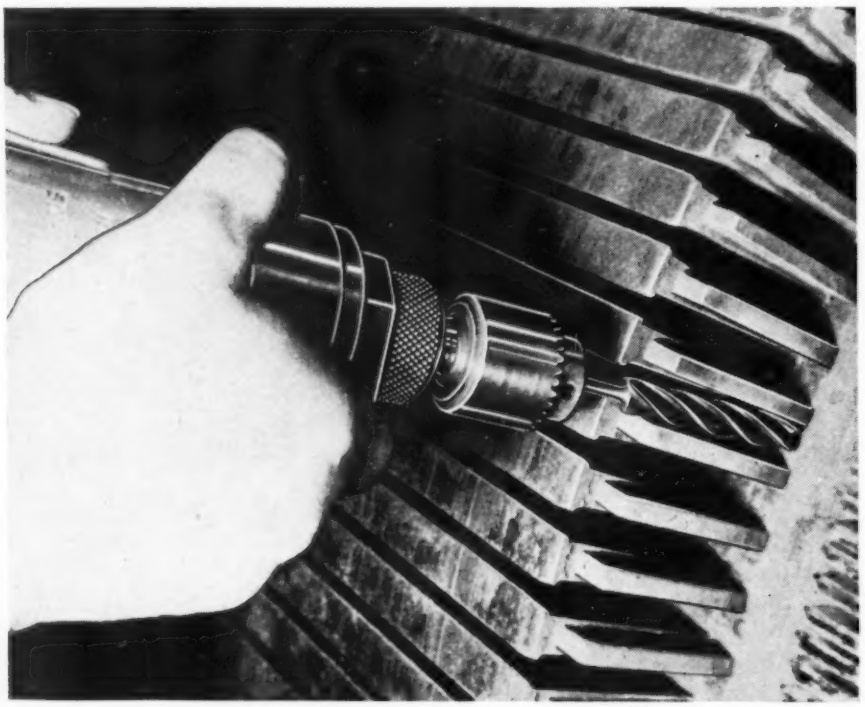
Estimated cost of the job was:

50 lb stainless-steel wire at 70¢	$35
800 lb steel grit at 6½¢	52
Labor—two men, 45 hr each at $1.00	90
2 cylinders of oxygen at $4.00	8
1½ cylinders of acetylene at $6.00	9
Miscellaneous materials—Lumber, rubber sheeting, etc.	20
	$214

Thus, at a cost of less than $215, metalizing restored to service a piece of equipment costing over $60,000 and not replaceable at the time of spraying.

PRACTICAL AIDS TO OPERATION

Plant-Tested Methods and Ideas for Power Men



AIR-DRIVEN END MILL CLEANS SLOTS

IN ONE OF OUR REPAIR SHOPS we use the method in the photo to clean old insulation and dried varnish from armature slots after stripping off the winding. Formerly we cleaned the slots with a file, but this was a tedious process. When looking for an easier, quicker method, the engineers hit upon the idea of using an end mill in an air drill. To permit the end mill to move freely in the slots its shank is recessed.

A girl can now clean armature slots, doing the work in about 10% of the time a file requires. This process no doubt can be applied to cleaning in other places where space is restricted.

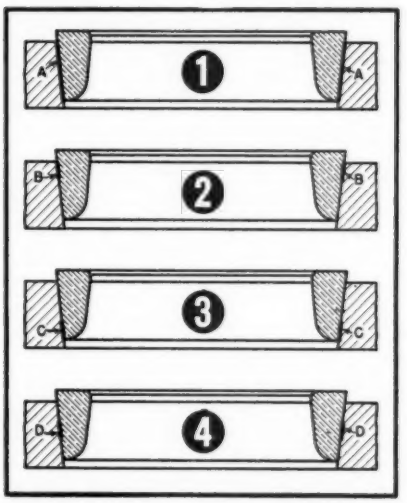
East Pittsburgh, Pa. H B LEIDY
Westinghouse Electric Corp

Center Fit Makes Tapered Seats Hold

SEVERAL bronze suction and discharge valve seat rings repeatedly jumped out of their seats in the liquid end of one of our large steam pumps. This pump has bowl valves on seat rings without supporting webs. The seats, which tapered on the outside, were press fitted in tapered holes in the valve decks, Fig. 1. The heavy line *A* between seat ring and valve deck indicates evenly distributed contact pressure in the fit.

We use the conventional prussian-blue check to fit the seats, but even though this indicated an excellent fit of the matching tapers, the rings jumped out of their seats. A study of the problem led to the conclusion that there was probably a difference in taper on the ring and in the valve decks that could not be detected with prussian blue. As a result the seat rings made their tightest fit at the top, Fig. 2, or at the bottom, Fig. 3, of the ring. In Fig. 2 and 3 the heavy lines *B* and *C* indicate location of closest fit. These locations of high-contact pressure area in the fits combined with repeated unequal expansion and contraction between seat and seat ring tended to cause the latter to creep and become loose.

Realizing the difficulty of making a perfect tapered fit, as in Fig. 1, I decided to fit the seat rings so that the greatest pressure would come near the seat's center, as at *D*, Fig. 4. I did this by first fitting each ring in its seat. Then, with fine emery paper I touched a trifle off both ends of the ring. Such a fit gives the ring a tendency to expand and contract in both directions from its center. As a result the forces tending to cause the ring to creep out of its seat are about balanced by equal opposing forces. Best proof of this theory is that the rings now remain tight.



Philadelphia, Pa. EMIL WITTMANN

Builds Pumps for Feedwater Treatment

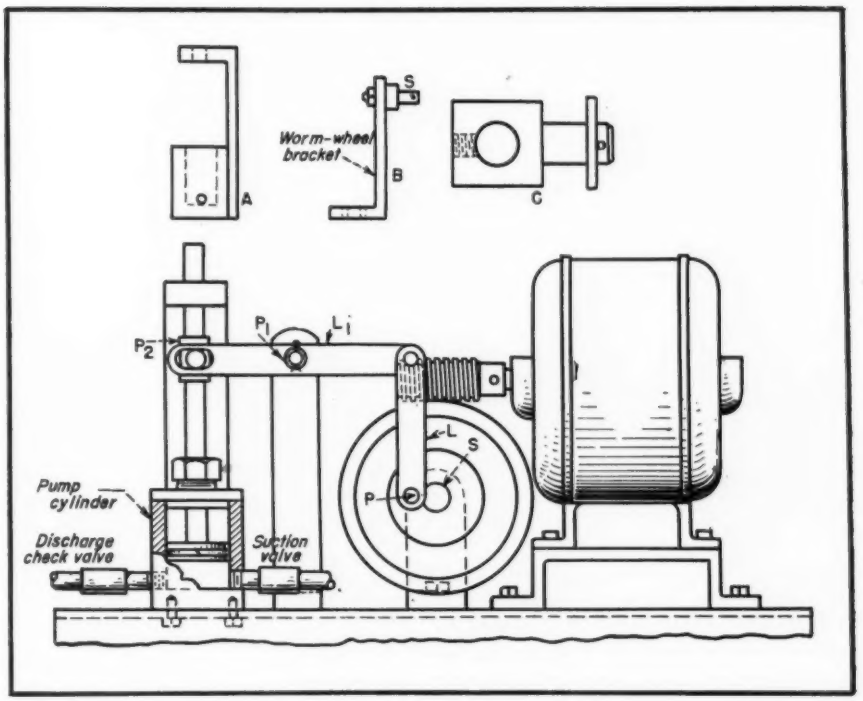
WE HAD TROUBLE supplying phosphate as an after treatment to our boiler feedwater. We used 24 lb per day, fed into the settling tank at 4-hr intervals when it was being filled. This method proved unsatisfactory. We next tried mixing the full day's supply with hot water and filling a 45-gal steel

drum, which we connected through a ¼-in. pipe to the hotwell, regulating the flow by a valve. This required too much attention because rate of flow varied with the level in the drum.

To eliminate these difficulties I designed and built the pump shown in the diagram. We made its cylinder from a piece of 2¼-in. round steel bored for a 1¼-in. piston and ¾-in. stroke. Cylinder and piston-rod guide assembly is shown at *A*. A ¼-hp 1450-rpm motor drives the pump through a worm and gear that gives a 125 to 1 speed reduction.

Wormwheel revolves on stud *S* fixed in bracket *B*. Pin *P*, offset from the wormwheel's center, connects by link *L* to one end of lever L_1. This lever pivoted at P_1 connects to the piston rod by adjustable pin P_2. Construction of this pin is shown at *C*.

We assembled the equipment on the back of a piece of 8-in. channel iron. and connected the pump's suction through a ball check valve to the treatment drum and the discharge through a similar valve to the open funnel over the hotwell that supplies the boiler feed pump. As the wormwheel turns it gives the pump piston an up-and-down motion and delivers a measured amount of treatment on each down stroke.



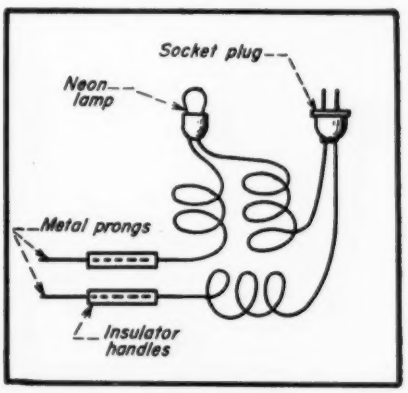
The pump has operated satisfactorily for several months with no other attention than putting a supply of phosphate solution in the drum every morning and cleaning the piping once a week by thoroughly flushing with plenty of clean water.

Thorold South, Ont. G BARRETT

CONDUCTIVITY TEST FOR RUBBER BELTS

STATIC-CONDUCTIVE RUBBER BELTS were developed especially for drives where a static spark might cause a fire or explosion. To insure that they retain their conductivity, test them at least once a month. Our engineers have developed an easy method for making such tests that can be used by anyone.

The equipment includes some lamp cord, a standard socket plug, a 2-watt neon lamp, two ordinary metal clamps or prongs with insulated handles, assembled as in the diagram. To make the test, moisten two short sections of the belt or other rubber product with water, leaving a dry section 8 to 12 in. long between the moistened surfaces. Then plug the testing assembly into a 110-v ac source and apply the prongs to the moistened surface with the dry



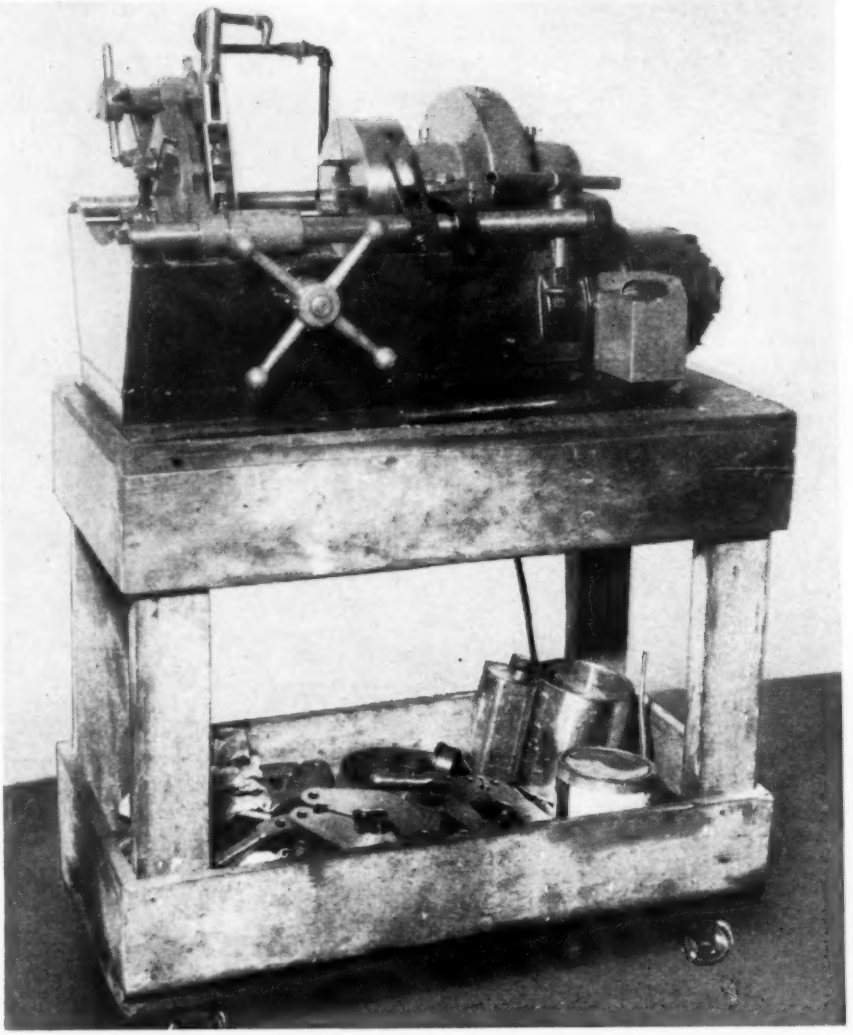
section between, as in the photo. If the neon lamp glows the rubber product is a static conductor. The belt or other product under test must be suspended in air or rest on a table or other insulated surface.

Akron, Ohio R E Powers
B F Goodrich Co

Make Pipe-Cutting Machine Portable

Pipe cutting and threading on the job involve a lot of hard work unless a machine can be used. Accordingly, we mounted a pipe cutting and threading machine on a portable bench, as in the photo. We made the bench of 2x4-in. joist and 1-in. boards, substantially fastened together. We mounted the bench on four 4-in. casters to move it easily in and out of elevators and from one location to another on a floor. A bin in the bench bottom provides storage for dies, sleeves, oil cans and other material required in a pipe-cutting job.

The machine's driving motor is fitted with a long extension cord with plug-in connector for attachment in the nearest wall power outlet. A forward and reverse switch permits running the machine in either direction to thread and back off. The machine is equipped with a chuck to hold and turn the pipe, a cutter to cut the pipe the desired length, dies for threading and a reamer to clean burrs from inside the pipe's end.



In this unit we have a complete shop to cut and thread pipe from ½ to 2 in. in diameter, which are the most commonly used sizes in the plant. We cut and thread larger sizes in the main pipe shop. Layout of the larger-size pipe is generally simpler and the pipe is more accurately measured for fabrication in the shop than the smaller sizes are.

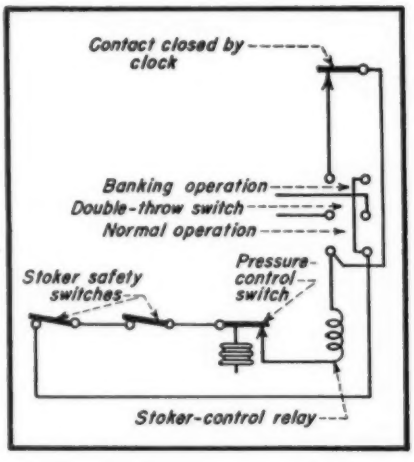
Chicago, Ill. J B Mullins

CLOCK SYNCHRONIZES WATCHMAN WITH STOKER

Operation of our stoker-fired boiler during banking periods is a responsibility of the factory night watchman. He has to be in the boiler plant during the few minutes that the stoker operates each hour. The stoker's control includes automatic banking actuated by a telechron clock. As originally connected this clock was energized only when the control was switched to banking.

One hour after the clock was energized it would close a contact to start the stoker for two minutes and every hour thereafter. Unless the day fireman switched to automatic banking at the same time each evening, the watchman did not know when the stoker would start, and the resulting confusion made it difficult for him to perform his duties in the plant efficiently.

To correct this difficulty I connected the clock so that it runs continually and closes its contact each hour on the hour. I connected this contact into the stoker control circuit with a 2-pole double-throw switch, as in the diagram. When this switch is closed to its bottom contacts the clock contact is cut out of circuit so that the stoker is under pressure-switch control only and operates to keep steam pressure at 125 psi. This is normal operation.



Near the end of a day, say at 4:30, when the fireman decides to switch to automatic banking, he closes the switch to its top contact. This puts the clock's contact in series with the pressure switch. This contact is open and does not close until five o'clock. By that time steam pressure has dropped to where

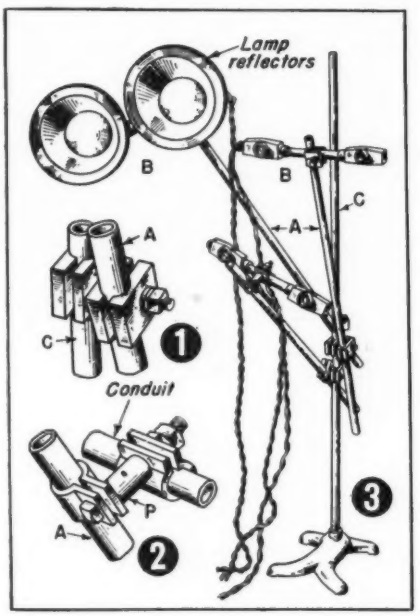
the pressure switch has closed. The stoker starts and operates for two minutes, when the clock opens its contact and stops it, and does not start again until one hour later.

Under this system the watchman, knowing that the stoker starts exactly on the hour, can be in the boiler room at that time. If an abnormal condition develops, for instance, if the stoker jams and shears a pin in its drive, the watchman is there to correct the trouble immediately.

Englewood, N. J. R BOETTINGER

Infra-Red Lamps Speed Insulation Drying

WE HAVE USED infra-red lamps extensively for drying electrical insulation, particularly when it has to be done on equipment in place. We built adjustable supports for the lamps that permit placing them in position for drying most efficiently. These simple supports are made chiefly of conduit and adjustable clamps assembled



around a vertical column *C* threaded into a cast-iron base, Fig. 3.

Clamps for supporting the lamps on the vertical column are made of four pieces assembled as in Fig. 1. Loosening the single bolt through the clamp permits moving its lamps to any desired position and then tightening them there. Lamps are assembled in groups of two in fittings at each end of a short conduit, as at *B*, Fig. 3, and connected to extension cords. These assemblies fasten to the ends of the supporting arms *A* by adjustable clamps, Fig. 2. In these clamps the parts that grip the conduit and supporting arm *A* are of ⅛-in. metal shaped to the conduit's circumference and held by a single bolt. A short length of pipe, *P*, between the two clamps holds the lamp conduit clear of its supporting arm. These clamps serve as a vernier on the column clamps to permit exact lamp location for the most efficient heating.

Infra-red lamps are of two types: carbon-filament and tungsten-filament, both of which give satisfactory drying service. They are available in 250-, 500- and 1000-w sizes and are made with the reflector inside the lamp or for a separate reflector. The most efficient reflectors are gold plated, but others are made of aluminum with a special finish on their reflecting surface.

Drying with infra-red lamps is much faster than in an oven or with other heating devices applied locally. The infra-red rays concentrate the heat on the insulation as soon as the lamps are energized. As a result moisture is more readily driven out of the insulation than when the coils are heated by convection and conduction from hot air.

With infra-red lamps, heating is in the open air; consequently free air circulation is obtained around the windings to carry away the moisture as quickly as it is liberated from the insulation. These lamps also apply the heat instantaneously whereas other devices may take two or three hours to get the job well started. For these reasons we find that a drying job can be done in about 25% of the time required for space heaters.

The Maintenance Co M A MYERS
New York, N. Y. Electrical engineer

WELDING REPAIRS CRACKED BOILER HEAD

WHEN A HANDHOLE is located below the tubes in the rear head of a hrt boiler, gasket leakage corrodes the plate below the handhole unless it is detected and stopped promptly. A moderate wasting of the plate can be built up by electric welding, but more severe corrosion requires inserting a steel-plate elliptical reinforcing ring and seal welding it to the edge of the handhole after chipping back to sound plate. Most engineers know how to protect the handhole plate and yoke with a basket of chicken wire covered with fire clay.

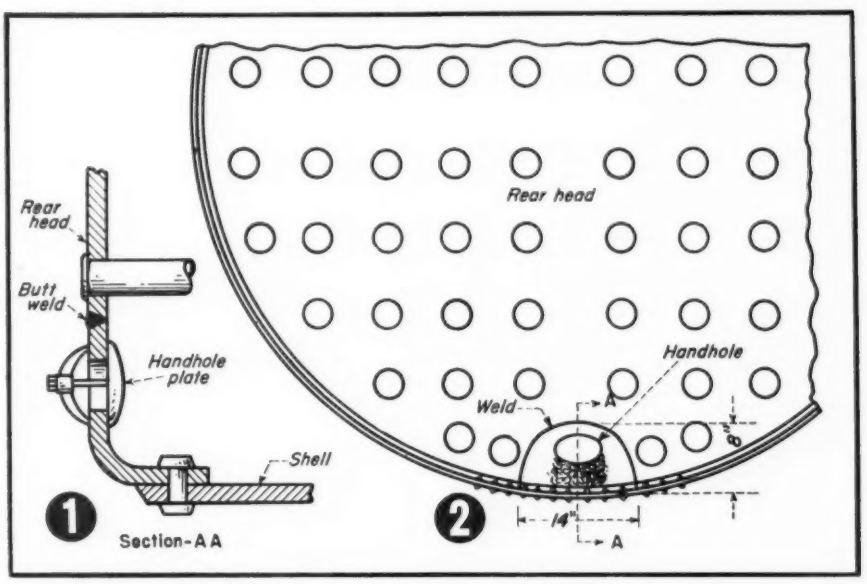
Recently corrosion below a handhole progressed down to the knuckle where the flange turns and penetrated so deep that a circumferential distance of several inches of the plate cracked. In this area plate was reduced to paper thinness making it impracticable to build it up by electric welding.

Fig. 1 and 2 show how a section of the defective head, including the handhole and several rivets in the head seam, were cut out and replaced with a patch.

After the defective portion was cut out using an acetylene torch and making the flame cut at a 45-deg. bevel, a patch plate, with handhole and rivet holes, was fabricated to fit the cutout.

A patch plate, of the same thickness as the original head, was made of open-hearth firebox steel. Its edges were cut to a 60-deg angle with the vertical to aid in obtaining a good weld. After patch was riveted in position it was properly aligned with a hammer and then electric welded.

Canton, Mass. H M SPRING



READER'S PROBLEMS

Exercise your engineering wits by submitting answers to these questions fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

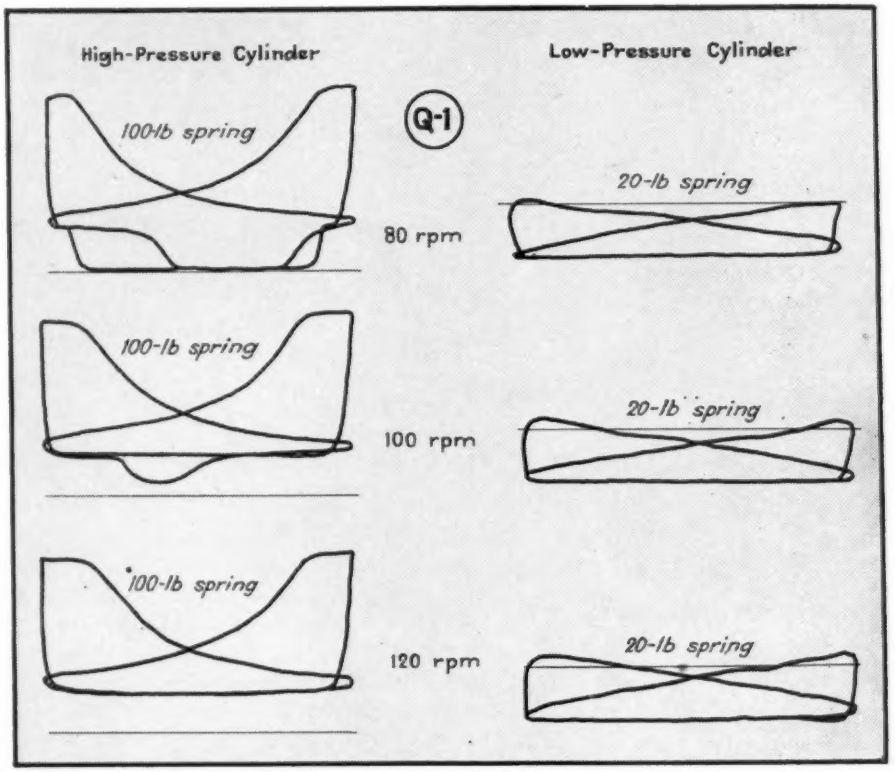
Questions From Our Readers

1—What Is Wrong With This Engine?

THE DIAGRAMS in Q-1 were obtained from a tandem-compound steam engine running, condensing and driving a rotary blower that compresses air from 15-in. water-column pressure to 5 psi.

Engine has poppet valves and adjustable cutoff. Here are other data: cylinders 15½ and 26x27 in.; 150 rpm; horsepower, normal 400, maximum 525; 6-in. steam line; 7-in. pipe serves as receiver between cylinders; 9-in. exhaust to condenser. Receiver is fitted with a trap and pressure relief valve set for 60 psi. Throttle pressure is 160 psi, 120-F superheat, and exhaust vacuum 25 in. Hg.

When operating at 120 rpm steam exhausts from h-p cylinder at 40 psi yet it enters the l-p cylinder at 5 psi. If engine speed is reduced to 100-80 rpm, exhaust pressure falls almost to atmospheric (see sketch) although it is released at about 40 psi. Two different indicators have been used and both checked for trouble such as loose springs. Instrument piping and receiver were checked for leaks. Can POWER readers explain this loss of pressure in the receiver between the cylinders?—*FKG*



2—Which Conveyer Is Best for Coal?

WE ARE INSTALLING a bin-feed stoker that will take coal from a storage bin adjacent to the boiler room. Coal will be trucked and dumped into a pit hopper at the base of the storage bin. Coal is 2 in. in size.

I expect to install a conveyer to lift the coal into the storage bin, a distance of 22 ft. How does a jet unit compare to a bucket conveyer in regard to initial and operating costs? Also what size tube (jet conveyer) and steam-supply pipe would be most satisfactory? Would it be best to insert the nozzle at the bottom and blow the coal up, or put the nozzle at the top and pull a vacuum on the line?—*JHL*

Answers to November Questions

How Can I Stop Generator-Field End Play?

(This is Question 1 from the November issue, with best answers from readers.)

We have a small motor-generator set, which consists of a 30-hp 1600-rpm shunt-wound 230-v dc motor belted to a 25-kw 4-pole 1800-rpm 440-v, 3-phase 60-cycle salient-pole rotating-field ac generator. The m-g set, used to supply variable-frequency power in a test shop, runs about eight hours each day. The set is made up of two units, mounted on a welded channel-iron base, which is bolted to a concrete foundation. Drive consists of four V-belts with cast-iron pulleys.

Ever since the machine was first assembled the generator's rotating field has hammered back and forth in end play while running. This motion, which appears to be independent of load or speed, causes the rotor to smack the bearings rather hard. The end play and magnetic center of the generator were checked and found normal. Oscillation of the rotor was ignored for about two years and was not investigated until recently when the hammering increased noticeably. The machine was disassembled and an inspection revealed that the constant pounding had damaged one of the bearings and caused the field pole spider to shift about a half inch on the shaft. The bearing was renewed and the spider pressed back to place but all efforts to stop the vibration failed. Will POWER *readers suggest some way to correct this trouble or how to fasten the rotor securely in place to stop the hammering?—MAC*

Machine M-G Bedplate

THE BEDPLATE on *MAC*'s m-g set should be machined to give level mounting points for the machines. I believe the ac-generator shaft is inclined one way or the other from a true horizontal position. Belt alignment should also be checked as these two conditions will produce shaft oscillation.

Hamilton, Ont. J A COULDEN

Check Pulley Balance

BEST WAY for *MAC* to stop end play of his generator is to start at the beginning and check everything. First check the motor for pulley and base alignment, also the armature and bearings for excessive play and vibration. Then check the alignment of generator rotor, bearings, pulley and base. I believe the end play is caused by misalignment of the pulleys.

After the machines have been checked individually, align them as a unit giving special attention to the cast-iron pulleys. When they are heavy compared to the size of the machine they will cause vibration if they are not carefully balanced.

Philadelphia, Pa. W T MULLEN

Mount Thrust Bearings on Generator

AN EASY WAY to control the oscillation in *MAC*'s m-g set is to provide thrust bearings on the generator. One bearing should be supported rigidly, the other being held in place with only sufficient pressure to prevent oscillation. A small force is generally sufficient to prevent oscillation in a small-size machine. Ball thrust bearings require less attention and give better service than other types although they may be more difficult to install. I suggest this "field method" which will work if machine is properly installed. Mount a carbon block in a bracket, as in sketch 1-A, and let it bear against the end of the shaft. Screw adjustment will allow for centering the rotor and taking up slack. A soft carbon brush will substitute satisfactorily for the carbon block.

Piney River, Va. I A BUTCHER

Align the Belts

TROUBLE WITH MAC'S M-G SET can be caused by the shaft being out of level, the belt being misaligned, or by too much end play.

To true the shaft, carefully check the bearings with a level and wedge up the slide rails until the generator is perfectly level. If the belts do not run true on the pulleys, align the machine by moving it on the bedplate until the belt centers run on the center of the pulley grooves. Belt-driven generator should have from $\frac{1}{8}$- to $\frac{3}{8}$-inch end play.

A poor foundation results in continuous vibration; therefore it should not only be constructed of good, sound material, but should extend down far enough to insure good support.

Tighten all bolts and screws to eliminate this source of vibration. If the knocking against bearings continues after these checks have been made reduce the end play by inserting a thin washer or two between the shaft collar and end of bearing on each side of spider.

If the rotor is out of balance serious vibrations are produced, which vary with the generator speed and cause end-play oscillations. To remedy this vibration remove the rotor from the generator and rest the shaft on two perfectly level knife edges. When the rotor thus mounted is given a slight motion either way, the heavy side rotates to the bottom. The rotor can then be balanced by drilling some holes in the heavy side or mounting weights on the light side.

Oaklyn, N. J. C A WILKES

Balance Magnetic Thrust

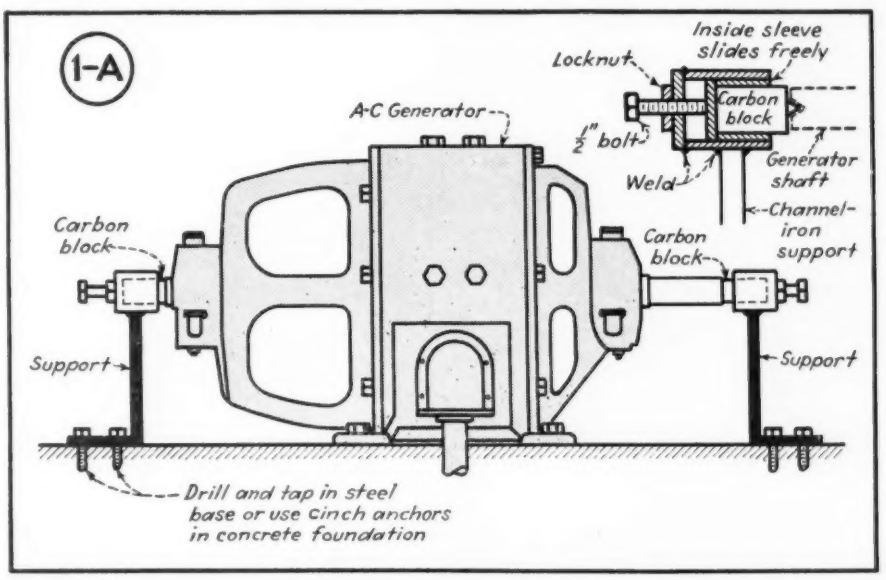
I BELIEVE MAC'S DIFFICULTY comes from bearing trouble, poles not magnetically centered, an unbalanced condition in the rotor, or possibly a combination of these conditions. If the bearings are in good shape and there is very little side play, the rotor should be kept from hammering on the bearing sides by the centering effect of the magnetic field.

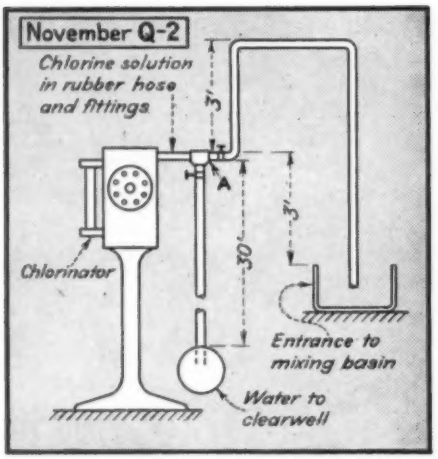
I suggest the end play be reduced as much as possible, until the rotor runs properly or the shaft collar rubs lightly against one bearing. If it heats, move the rotor so the magnetic pull will relieve the shaft thrust. Some points should be found where there is a balance and the end play stopped completely. Check rotor and pulley for balance. Centering the rotor inside the stator air gap is important and should be checked.

Carlsbad, N. M. E A ROBERTS

Install Rings on Shaft

I SUGGEST that *MAC* check the generator in operation by pressing against the shaft with a block of wood first at one end and then at the other. If the rotor is properly





centered, it should be pushed easily from either end. The rotor can be held securely in place by installing a small steel ring on the shaft on each side of the spider. These rings should be pressed snugly up against the inside of each bearing and spotted about three places with an arc welder. I believe that the V-belts are causing the damage. The machines may be just a little out of line because *MAC* has replaced some of the belts at various times. Operating with old and new belts produces irregular pull with load changes and causes oscillation.

Shiprock, N. M. J F MAHER

Check End Play

AMOUNT OF MAGNETIC EFFECT causing end play in *MAC*'s generator field can be checked by operating at normal speed with the generator disconnected from the power system.

If the cause is found to be mechanical carefully check the alignment as well as the condition of V-belts and sheaves. If the driving motor and generator shafts are parallel and the belt sheaves true, install thrust collars or bearings.

If the fault is traced through elimination of electrical and mechanical defects to the generator bearings discuss the problem with the generator manufacturer to determine the type and location of thrust bearings and minimum end play permissible.

Saint John, N. B. C G CLARK

What Happens to Branch Distribution?

(This is Question 2 from the November issue, with best answers from readers.)

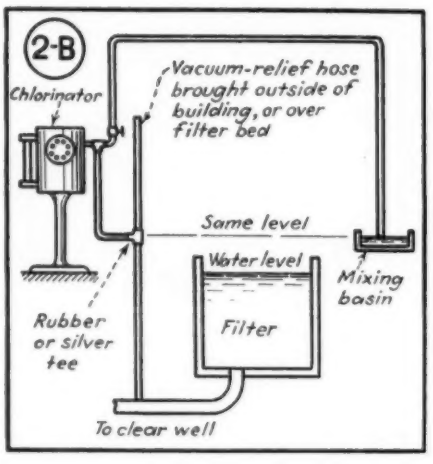
Originally our chlorinator was connected to supply chlorine solution into the water header leading from filter beds to clearwell. During summer months chlorine dosage is so high that it leaves considerable taste and odor in the water. I experimented by adding a chlorinated compound to the raw-water mixing basin to determine if prechlorination would permit reducing chlorine feed to filtered water. This gave good results, and I decided to divide chlorine-solution feed from chlorinator between the mixing basin and clearwell. Hookup is shown in sketch November Q 2.

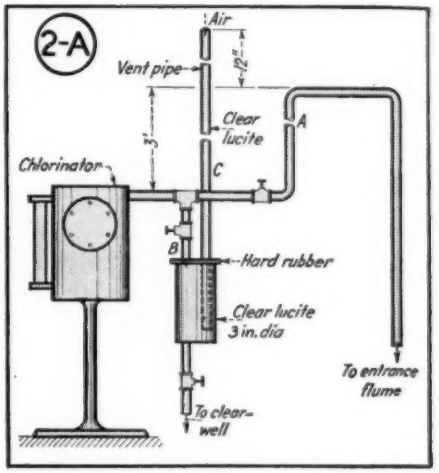
When starting up I expected to regulate feed to each branch by adjusting the valves at A *but results were not satisfactory. Branch to clearwell pulls the solution away from mixing-basin branch, which runs along the ceiling 3 ft. above the chlorinator. How can I break the vacuum on clearwell branch so that distribution can be regulated? (Chlorinator ejector supplies adequate pressure to force solution to the basin.)—LCR*

Install a Vent And Lucite Chamber

LCR DOES NOT STATE the amount of vacuum in his clearwell pipe. I believe that if the valves used have fine enough adjustment he could overcome the vacuum by throttling the pipe leading to the clearwell. It is also possible that water flow is not large enough to give much regulation. That can be remedied by increasing the size of the injector to force more water through the piping and valves.

If this does not work I suggest *LCR* use the method outlined in sketch 2-A which shows line *B* running into a lucite plastic chamber. This chamber is 3 in. inside diameter and 12 in. long, with a vent pipe *C* which is open at bottom and top. This vent would extend about 12 in. above the pipe *A*, which runs along the ceiling 3 ft above the chlorinator and over to the basin he wishes to chlorinate. This





device would allow air to enter the clearwell pipe and break the vacuum. The lucite chamber gives visual operation.

If the water is not highly chlorinated he can run pipe *B* into an open box with a float valve to check overflow. The water would then run by gravity to the clearwell pipe or could be sucked into the clearwell by the vacuum which apparently exists there.

Highly chlorinated water generally contains some gas therefore this would be objectionable and I recommend the trap, sketch 2 A.

Los Angeles, Calif. J R MUDGE

Use Vacuum-Break Tee at Mixing Basin

PRESSURE HEAD in that section of chlorine hose leading to the clearwell line will vary according to the loss of head between the water level in the filters and the clearwell line. When loss of head is small, pressure in the chlorine discharge line will more nearly approach that of the line going to the basins, thus making equal distribution between the two easier to control by means of the valves already supplied at *A*. Sketch Nov Q-2.

However, as the loss of head in the filter increases, pressure on the chlorine line leading to the clearwell will drop, while that of the other chlorine line will remain the same. This difference causes more chlorine solution to flow to the clearwell and less to the basin.

To correct his trouble *LCR* should insert a hard-rubber or silver tee in the solution line leading to the clearwell pipe sketch 2-B. This tee should be level with the outlet of the line going to the basin. A rubber hose should be extended from this tee to any convenient height above the water level in the basin. The pres-

sures on both branches of the chlorine lines would then be equal at all times and flow adjustments can be made at the valves.

The extended hose from the tee should be open to the atmosphere, and thus act as a vacuum break. If the filter plant is laid out according to the conventional design, the top of the relief hose will be higher than the water surface in the filters, and there will be no danger of overflow from this vacuum break.

Kansas City, Mo. E E WOLFE

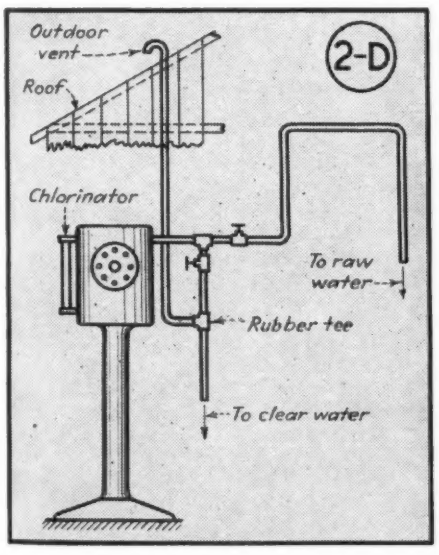
Add Outdoor Vent

METHOD USED in *LCR*'s question to obtain both prechlorination and after-chlorination from the same chlorinator is questionable.

Since taste is mentioned, I assume the purpose of chlorination is to render a water supply safe for human consumption. If this is true, it is poor practice to rely on a single chlorinator.

The difficulty with the present arrangement could be overcome by inserting a rubber tee below the valve in the solution feed line to the clearwell. A vent hose, which would break the vacuum, could then be extended to the roof and outdoors, as in sketch 2-D. The outdoor discharge would eliminate the chance that chlorine might escape into the building.

Activated carbon can also be used with

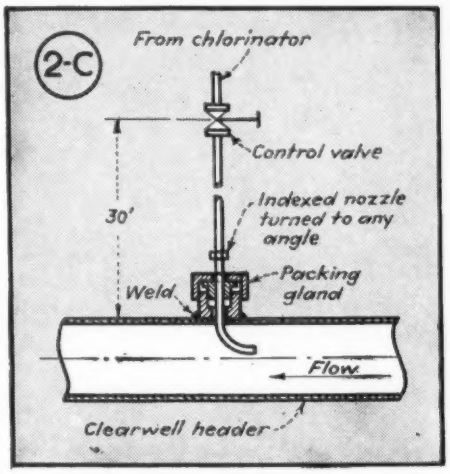


considerable success where taste and odor are objectionable. This is of course applied before coagulation. The use of the chloramine process is also effective in taste and odor control.

Hamilton, Ont. J A COULDEN

Insert Nozzle in Header To the Clearwell

SOLUTION OF LCR'S PROBLEM depends on the pressure in the clearwell header. If this pressure is above atmospheric and the suction produced is caused by flow



past the chlorine feed pipe the suction effect can be controlled by a nozzle inserted as in sketch 2-C so it can be turned at any angle to adjust differential pressure. An index on the nozzle will provide a convenient calibration marker.

If clearwell header pressure is not more than 12 psig the pipe could be broken just below the control valve on the branch line and a funnel installed. This would equalize pressures at each discharge point.

A 2-element positive chemical feeder could be used regardless of pressure conditions in the clearwell header. Feeders are available in a wide range of styles and can be driven from rotating or reciprocating shafts of direct-connected motors.

Electric timers operate solenoid or motor-operated valves in each branch. If intermittent flow is not objectionable these timers will give any desirable time of operation between the two valves.

St. John, N. B. C G CLARK

Install Check Valves

I SUGGEST that *LCR* secure two plastic injection nozzles with double check valves. With these nozzles and rubber double checks there will be no chance for syphon action from the mixing line. Solution will be fed only while there is pressure from the feeder, and the double check will prevent flow otherwise.

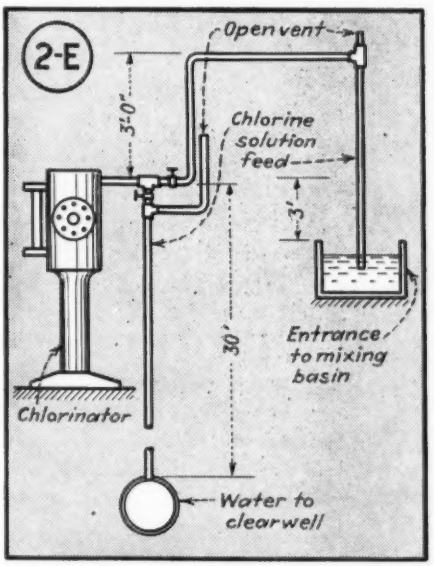
I suggest that *LCR* obtain a chlorine comparator to check his feed. During summer months the water will not require as much dosage because it usually carries less chlorine absorbing matter and the residual is high. He probably does not need to dose the mixing basin because the water requires more dosage before it is filtered than after. He can feed a weaker solution if the same quantity of liquid is needed.

Shiprock, N. M. J F MAHER

Vent Both Feed Lines From Chlorinator

WHEN LCR FEEDS CHLORINE SOLUTION into the clearwell supply line and entrance to the mixing basin the clearwater flow tends to create a vacuum in the solution line feeding the mixing chamber. All that is necessary to break this suction is to install a tee in the line to the clearwell with a branch turned up and left open, as in sketch 2-E. Locate this tee between the clearwell and solution feed valve and as close to the valve as possible.

If the outlet of the solution feed line to the mixing basin is submerged it may be necessary to install a tee at the top of the long leg, with a piece of open pipe extended up from the tee. This will break any vacuum on the chlorinator originating in the discharge line. If the pressure head in the water supply line to



the clearwell is more than 30 ft, raise the point of the solution feed so the vertical distance from the water-supply line to the point of feed is greater than the head on the clearwater line.

Piney River, Va. I A BUTCHER

CENTRIFUGAL PUMP Q AND A FOR POWER ENGINEERS

By I J Karassik and Roy Carter

11—Factors That Affect Pump Operation

Eleventh in a monthly series by Igor J Karassik and Roy Carter, Worthington application engineers. These two experts on centrifugal pumps have selected questions and answers that give a broad, practical understanding of the pumps, their construction, operation, characteristics, troubles and remedies.

Q 1—What is water horsepower?

A—Incidentally it should be called liquid horsepower and is the hydraulic power generated by a centrifugal pump. It equals pump capacity in gallons per minute, times the total head in feet, times the specific gravity of the liquid, divided by 3960. If a pump discharges 1800 gpm of cold water against 110-ft total head, water horsepower (whp) = 1800 x 110 x 1 ÷ 3960 = 50.

Q 2—What is brake horsepower?

A—It is the power required to drive a pump and equals its water horsepower divided by the pump's efficiency. It is frequently called horsepower. If a pump's efficiency is 0.80 and its water horsepower 50, brake horsepower (bhp) = 50 ÷ 0.80 = 62.5.

Q 3—What are the losses in a centrifugal pump?

A—They are classified as: (a) hydraulic (b) disk-friction (c) leakage or short-circuit and (d) mechanical.

Q 4—What are hydraulic losses?

A—They are losses caused by shocks, eddy currents and friction of the fluid in its path through the impeller and casing waterways.

Q 5—What are disk-friction losses?

A—Disk-friction losses, (commonly called disk-horsepower) are the power required to rotate the impeller in the liquid surrounding it in the pump casing. With other factors constant, the disk horsepower increases rapidly with viscosity of the pumped liquid.

Q 6—What are short-circuit losses?

A—They are losses caused by leakage from the discharge to the suction side of a pump through the clearances between the casing and impeller wearing rings. This leakage reduces the pump's effective capacity because the leakage has to be repumped from suction to discharge.

Q 7—What are mechanical losses?

A—They are the losses resulting from friction in the stuffing boxes and the pump's bearings.

Q 8—How does a liquid's viscosity affect a pump's disk-friction losses?

A—They increase with increase in viscosity because the thicker a liquid the more power is needed to rotate the impeller through it. If viscosity is sufficiently high to reduce the head generated by the pump, the impeller's diameter must be increased to recover this head loss, thus further increasing disk-friction losses, which vary about as the fifth power of the impeller's diameter.

Q 9—How does a liquid's viscosity affect a pump's total head?

A—The head-capacity curve of a centrifugal pump handling a viscous fluid does not duplicate the head-capacity curve of the same pump when handling water. The effect of viscosity on a typical pump's performance is indicated in Fig. 1. For example, when handling water at 120 gpm, the pump develops 44-ft head, point *A*, but when handling a liquid of 1000 SSU viscosity at 120 gpm

(*Continued on page* 120)

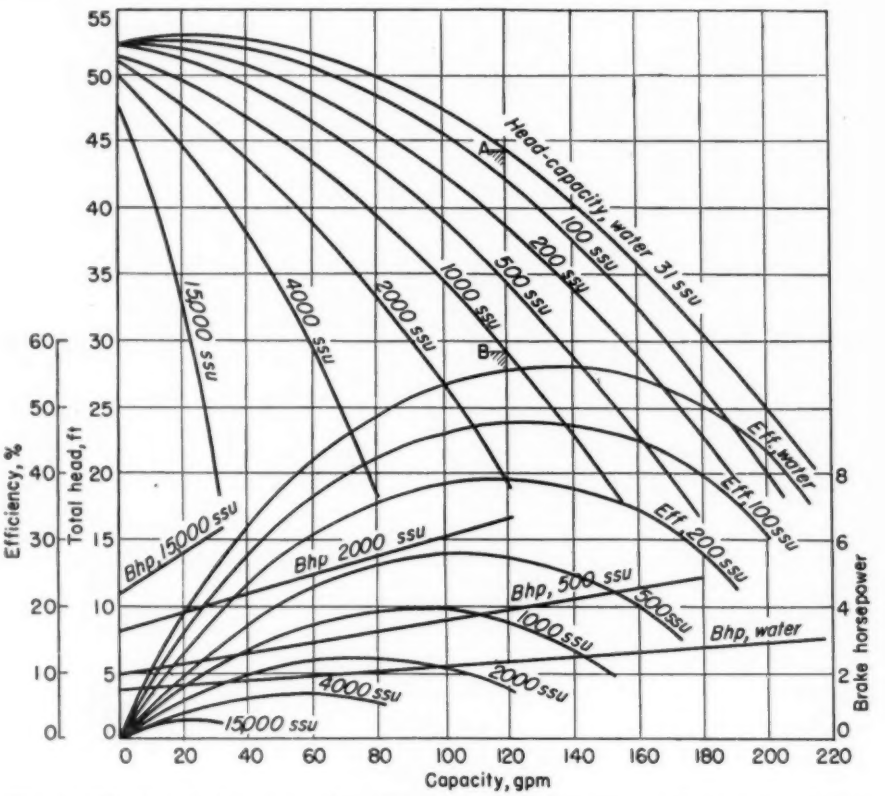


Fig. 1—Effects of change in viscosity on centrifugal-pump performance. As viscosity increases, the pumping head and efficiency decrease for a given capacity

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OPERATING MECHANISM—Available as skeleton for building into machines, etc. Metal parts rust-proof. Rubber mounting absorbs shocks. Mechanism removable as a unit by loosening one screw—for wiring, etc. Parts and terminals easily accessible.

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PUMP Q&A *Continued*

it develops a head of only 29 ft, point *B*. This loss of head with increasing viscosities is caused by increased friction head as well as by the viscosity's over-all effect on the flow configuration in the impeller and casing.

Q 10—How does a liquid's viscosity affect pump efficiency?

A—Since two of the losses in a centrifugal pump, disk horsepower and friction head, increase with increased viscosity, the efficiency of a pump handling viscous liquids will be lower than one handling water, as indicated in Fig. 1. How much it will decrease depends on the type of pump, its hydraulic design and the relation of its operation to the conditions at best efficiency as well as to the liquid's viscosity.

Q 11—How does a liquid's viscosity affect pump selection?

A—Because disk friction varies as the fifth power of the impeller's diameter and only as the speed cubed, it is desirable to use the highest speed (and resulting smaller impeller diameter) consistent with design conditions. Head loss due to viscosity increases as operating conditions approach the best efficiency point of the pump because of increased velocity through the impeller. Therefore, there is an advantage in selecting a relatively oversized pump for a highly viscous liquid so as to place the operating conditions well to the left of capacity at best efficiency on low-viscosity service.

Q 12—What range of efficiencies is obtainable with centrifugal pumps?

A—The efficiency of a centrifugal pump depends on many factors, such as the pump's specific speed, its relative size, the service for which it is intended, materials of which constructed and physical characteristics, such as the liquid's viscosity. Large centrifugal pumps have developed over 92% efficiency. Small pumps handling viscous liquids, under severe mechanical conditions calling for relatively large clearances between the wearing rings, may have efficiencies as low as 10 or even 5%.

Q 13—What is a pump's design speed?

A—It is the speed at which the pump was designed to operate and deliver its rated capacity (gpm) against its rated head in feet. Thus the design speed is the pump's normal operating speed. At a speed higher than normal, pump's head and capacity increase and at speeds below normal, they decrease.

Q 14—How does a speed change affect pump performance?

A—Its capacity varies directly as the speed; its head as the square of the speed and its power input as the speed cubed. Example: A pump, which delivers 1000 gpm against 100-ft total head at 1000 rpm, point *A*, Fig. 2, and requires 40 hp to drive it, point *B*, will deliver 900 gpm against 81-ft total head when run at 900 rpm, point *C*, and will require 29.2 bhp to drive it under those conditions, point *D*. All points on the characteristics are similarly affected so that if the ones for one speed are known, those for another speed can be predicted.

If pump speed is increased sufficiently, limit of operation at the prevailing suction conditions can be exceeded and its head and capacity range will be reduced. Likewise, if the speed is reduced excessively, the pump's efficiency will be somewhat reduced so that its power input will no longer follow the speed-cubed relationship.

Q 15—How does a change in impeller diameter affect pump performance?

A—Since the impeller's peripheral

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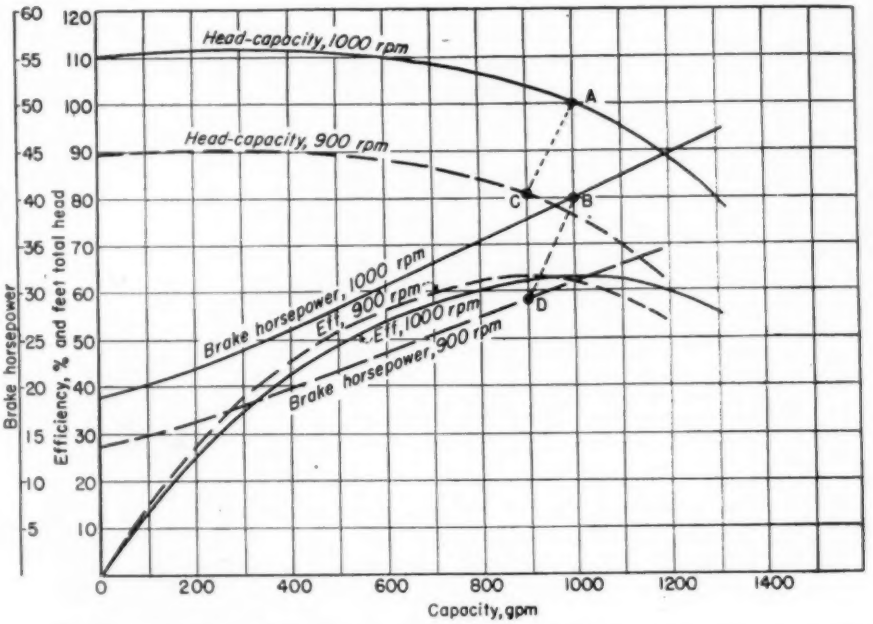

Fig. 2—Head-capacity, efficiency and horsepower performance curves of a centrifugal pump operating at 1000 and 900 rpm, when handling the same liquid

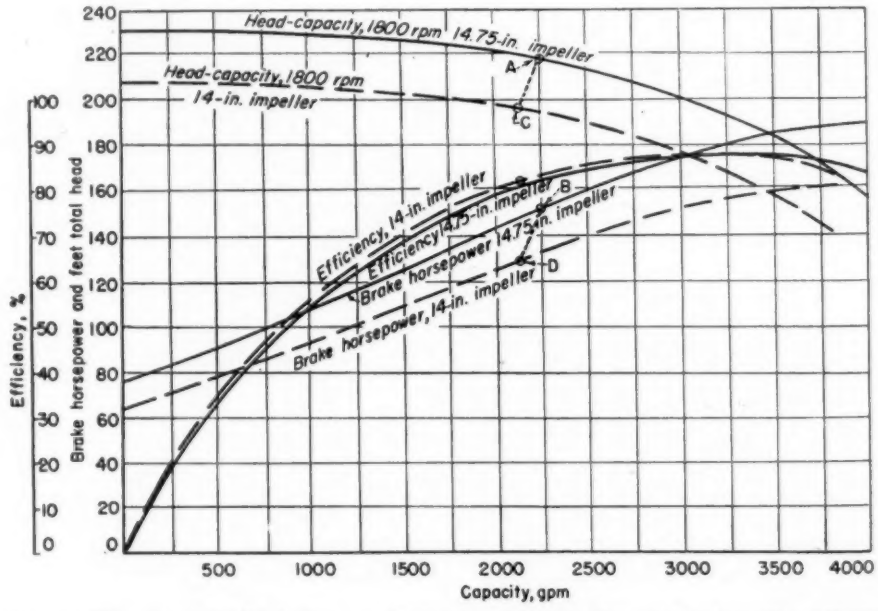

Fig. 3—The curves indicate how a change in the diameter of the impeller affects a centrifugal pump's performance when the other conditions remain the same

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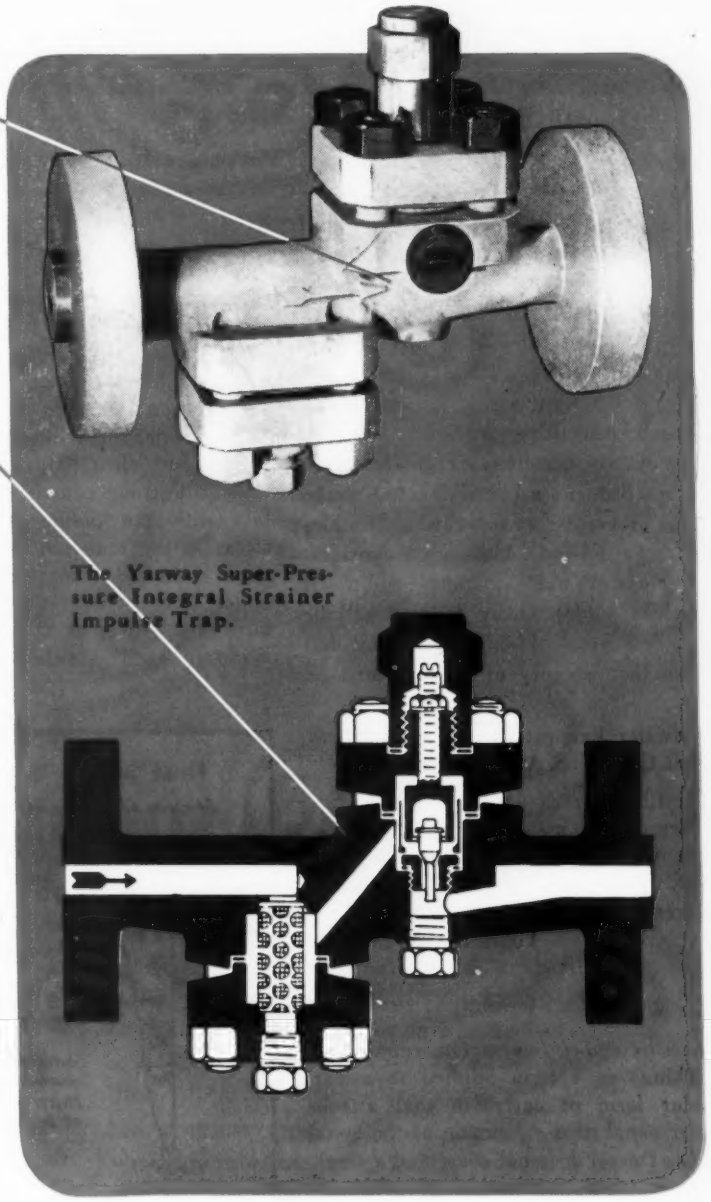
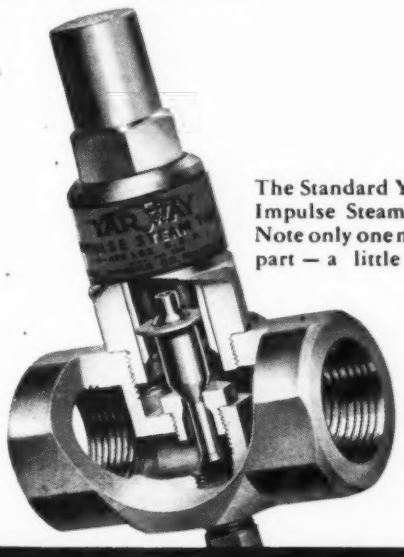


The Yarway Super-Pressure Integral Strainer Impulse Trap.



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WATER-TREATMENT QUESTION BOX

CAUSTIC EMBRITTLEMENT

By K M Herstein and John S G Shotwell

▶ IF POLYSYLLABIC TECHNICAL TERMS in boiler- and process-water-treatment terminology bother you here is a series on water conditioning that will shed light on your problem. This first article lays bare the facts of caustic embrittlement. The questions, written in letter form, will come from the files of Karl Herstein, of Herstein Laboratories, Inc, and John Shotwell, consulting engineer.

To discuss questions of greatest general interest, those pertaining to specific plant processes or operating troubles have been deleted. Although a considerable number are on hand, additional questions submitted by readers will be given every consideration if they fall within the category of general interest.

Goodwater Laboratory
Drum City, U. S. A.

Dear Chemist:

Please tell me in simple language what you mean by "caustic embrittlement." Also explain the causes and how to prevent it in a boiler.

Yours truly,
Walter Tender

Dear Walter:

Caustic embrittlement (intercrystalline cracking) is a term applied to a particular form of corrosion that attacks boiler metal at the junction of the metal grains (metal does not consist of a single uniform piece, but rather of extremely fine grains bonded together). This form of corrosion usually occurs in drum seams, under rivets, and at rolled-tube joints; if the metal is highly stressed, cracks appear.

This intergranular corrosion is caused by caustic (sodium hydroxide) in the boiler water, concentrating in locations where two layers of metal are held together mechanically to form a seam, or in other places where narrow crevices occur. The water entering these is turned into steam leaving the solid caustic behind, and more water then enters the crevice to be evaporated. But because of the contour of the narrow space, the solid residue is not washed out by the incoming water, but left to concentrate and attack the hot metal along the lines of least resistance, namely, the intergranular boundaries. It is believed that silica acts as an accelerator in this action.

Caustic embrittlement is caused by a combination of four factors, namely: (1) presence of sodium hydroxide (2) presence of silica (3) localized production of a strong caustic solution in contact with the boiler metal (4) high stress in the region of attack. Most of these conditions can be present in any boiler from time to time, and to minimize embrittlement it is advisable to maintain such a ratio of sulphate to total alkali in the boiler water as to reduce to the minimum the danger of local concentrations of free caustic.

In high-pressure boilers extreme care must be taken to reduce this danger, as the rapidity of the chemical action is increased with an increase in temperature and pressure. The caustic alkalinity has to be reduced to an extremely low concentration or embrittlement must be prevented by adding sodium phosphate, sodium nitrate, tannins, lignins or other inhibitors. The concensus of opinion seems to be that sodium hydroxide is the active chemical, but that silica assists in localizing attack at grain boundaries.

Yours truly,
Chemist
Goodwater Laboratory

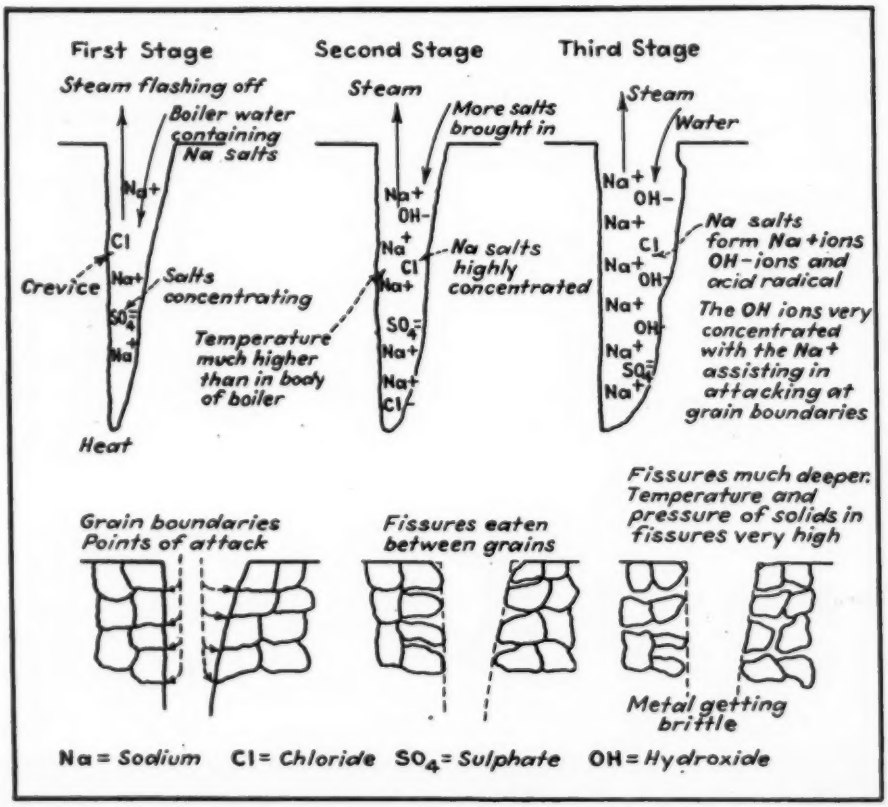
First Stage
Second Stage
Third Stage
Steam flashing off
Boiler water containing Na salts
Steam
More salts brought in
Steam
Water
Crevice
Salts concentrating
Na salts highly concentrated
Na salts form Na+ ions OH− ions and acid radical
The OH ions very concentrated with the Na+ assisting in attacking at grain boundaries
Temperature much higher than in body of boiler
Heat
Fissures much deeper. Temperature and pressure of solids in fissures very high
Grain boundaries Points of attack
Fissures eaten between grains
Metal getting brittle
Na = Sodium Cl = Chloride SO4 = Sulphate OH = Hydroxide

Fig. 1—Caustic embrittlement usually occurs in seams, under rivets and at rolled-tube joints, and if the boiler metal is highly stressed, cracks will soon appear

20,010 HOURS-OF TROUBLE-FREE OPERATION

SUN DIESEL LUBRICANT . . .

Keeps big Diesel-driven compressors running smoothly

Twenty-four hours a day . . . 20,010 hours of almost continuous work . . . no time-out for any but routine maintenance . . . and no apparent wear. That's the record of these four, big, Diesel-driven air-compressors, lubricated with Sun Solnus Oils.

Installed in a huge industrial plant, one week before Pearl Harbor, these 400-h.p. units have given outstanding service. Sun Solnus Oil was used for both Diesel power and air-compressor sides from the very first day . . . was chosen for its low carbon-content . . . its ability to keep rings free and clean . . . the fact that it doesn't form harmful acids or hard, flinty deposits . . . and doesn't break down into thick, sticky sludge.

This record is the kind which Sun industrial products are helping to hang up in hundreds of different plants . . . the kind of record that means continuous production . . . low operating-costs . . . a minimum of time-out . . . reduced labor costs.

Sun products prolong machine-life; save power, materials, and labor; not only in power-plants and factories, large and small, but throughout industry.

The telephone on your desk is a direct wire to the Sun Engineers and service men in your area. Call them in today.

SUN OIL COMPANY • ***Philadelphia 3, Pa.***

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SUNOCO **SUN INDUSTRIAL PRODUCTS**

OILS FOR AMERICAN INDUSTRY

MATH TIPS

PHIL SWAIN GIVES HELPFUL HINTS TO EVERYDAY USERS OF NUMBERS AND HOMESPUN MATHEMATICS

8—Square Root: The Easy Way

The square-root method I shall describe here is a personal hobby and original with me. By that I don't mean that nobody else ever discovered it. That is unlikely with a method so simple and obvious. I mean merely that I never heard anybody mention this rule:

1. Move decimal point left or right (as necessary) in jumps of *two places* at a time until a number between 1 and 100 is obtained.

2. By inspection find the *whole number* (no decimal places, please) closest to the desired square root. Call this the *first root.*

3. Divide the first root into the number and carry the result to *one decimal place only.* Call this *the first quotient.*

4. Average the first quotient and the first root to *one decimal place only.* Call this *the second root.*

5. Divide original number by second root. Carry result to *four decimal places* and call it *second quotient.*

6. Average second root and second quotient. Carry result to *three decimal places.* (Table has been carried to 4 places to show more clearly what the error is.) This will be the square root of the number obtained in step 1. Its error will not exceed 0.003.

7. Note how many *double* places the decimal point was moved in step 1. Move it back *the same number of single places* in the opposite direction.

Example Worked Out

The steps below are numbered from 1 to 7 as in the rule above:

1. To get square root of 263,400, first move decimal point two double steps left to give 26.34.

2. Five squared is 25 and 6 squared is 36, so select 5 (the closest) as the first root.

3. Dividing 26.34 by 5 *to 1 decimal place* gives 5.2, the *first quotient.*

4. Averaging 5 and 5.2 *to 1 decimal place* gives 5.1. This is the *second root.*

5. Dividing 26.34 by 5.1 to 4 decimal places gives 5.1647. This is the second quotient.

6. Averaging 5.1 and 5.1647 to 3 decimal places gives 5.132. This is square root of 26.34.

7. Moving decimal point two single steps right gives 513.2. This is correct square root of 263,400 to the first decimal place.

Mathematicians will recognize this as a method of successive approximation. But even trained computors may need the warning to carry to the exact number of places listed in the rule. To use more places wastes time and is not necessary to achieve the indicated accuracy.

The table shows the actual error of this method for 41 examples covering the range from 1.1 to 97.0. In no case does the error exceed ⅓%. Most results are much closer than that.

STEPS IN FIGURING SQUARE ROOT

For 41 examples from 1.1 to 97.0

Number	First Root	First Quotient	Average Second Root	Second Quotient	Average Final Root	Exact Square Root to 4 Decimal Places	Error Less Than			
							1/3 %	1/10 %	1/50 %	1/200 %
1.1	1	1.1	1.0	1.1	1.0500	1.0488	*			*
1.2	1	1.2	1.1	1.0909	1.0954	1.0954				
1.3	1	1.3	1.2	1.0833	1.1416	1.1402	*			
1.4	1	1.4	1.2	1.1667	1.1833	1.1832			*	
1.6	1	1.6	1.3	1.2308	1.2654	1.2649		*		
1.8	1	1.8	1.4	1.2857	1.3428	1.3416		*		
2.0	1	2.0	1.5	1.3333	1.4166	1.4142	*			
2.2	1	2.2	1.6	1.3750	1.4875	1.4832	*			
2.4	2	1.2	1.6	1.5000	1.5500	1.5492		*		
2.6	2	1.3	1.6	1.6250	1.6125	1.6125				*
2.8	2	1.4	1.7	1.6471	1.6735	1.6733			*	
3.0	2	1.5	1.7	1.7647	1.7323	1.7321			*	
3.5	2	1.8	1.8	1.9444	1.8722	1.8708		*		
4.0	2	2	2	2	2	2				*
4.5	2	2.2	2.1	2.1429	2.1214	2.1213				*
5.0	2	2.5	2.2	2.2727	2.2363	2.2361			*	
5.5	2	2.8	2.4	2.2917	2.3458	2.3452		*		
6.0	2	3.0	2.5	2.4000	2.4500	2.4495		*		
6.5	3	2.2	2.6	2.5000	2.5500	2.5495			*	
7.0	3	2.3	2.7	2.5925	2.6463	2.6458			*	
7.5	3	2.5	2.7	2.7778	2.7389	2.7386			*	
8.0	3	2.7	2.9	2.7586	2.8293	2.8284		*		
8.5	3	2.8	2.9	2.9310	2.9155	2.9155				*
9.0	3	3	3	3	3	3				*
9.5	3	3.2	3.1	3.0645	3.0823	3.0822				*
10.0	3	3.3	3.1	3.2258	3.1629	3.1623			*	
11.0	3	3.7	3.3	3.3333	3.3166	3.3166				*
13.0	4	3.2	3.6	3.6111	3.6056	3.6056				*
15.0	4	3.8	3.9	3.8461	3.8730	3.8730				*
19.0	4	4.8	4.4	4.3182	4.3591	4.3589				*
23.0	5	4.6	4.8	4.7917	4.7958	4.7958				*
27.0	5	5.4	5.2	5.1923	5.1961	5.1962				*
35.0	6	5.8	5.9	5.9322	5.9161	5.9161				*
45.0	7	6.4	6.7	6.7164	6.7082	6.7082				*
55.0	7	7.9	7.4	7.4324	7.4162	7.4162				*
65.0	8	8.1	8.0	8.1250	8.0625	8.0623				*
75.0	9	8.3	8.6	8.7209	8.6604	8.6603				*
85.0	9	9.4	9.2	9.2391	9.2195	9.2195				*
93.0	10	9.3	9.6	9.6875	9.6437	9.6437				*
95.0	10	9.5	9.7	9.7938	9.7469	9.7468				*
97.0	10	9.7	9.8	9.8980	9.8490	9.8489				*

HOW YOU CAN SIMPLIFY YOUR 1946 STEEL VALVE PROCUREMENT PROBLEMS

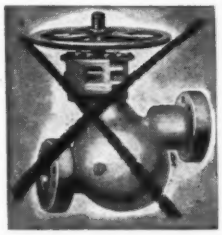
An Annual Report to Steel Valve Users

THROUGHOUT the war, steel valves were among the most critical of all common components and though the industry's capacity was expanded substantially, many types of steel valves are, and will continue for some months to be, very tight.

The time lag on deliveries depends upon size and type of valves. Production of large, cast steel valves is running behind schedule because of uncertain foundry production and labor conditions. Too, there is a substantial pent-up demand in certain civilian industries which were unable, during wartime, to obtain the high priorities which were always required for steel valves.

HELP YOURSELF

You can simplify your 1946 steel valve procurement in several ways:



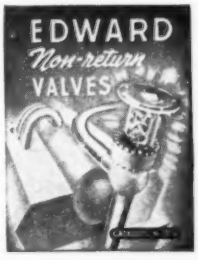
1. Avoid special designs. Standard valves are in continual production, whereas "specials" usually require engineering department time, extra pattern or die work, and special handling in the forge shop or foundry.

2. Anticipate your requirements and place orders early. While we are able to supply many sizes and types of standard valves out of stock shipment now, demands are still so heavy that single orders may nearly wipe out the stock in one size or pressure class.

ORDER CURRENT DESIGNS

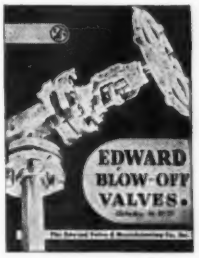
You can also simplify your purchasing problem if you order from the most recent catalogs. During the past year, we have issued three new catalog sections which should be in your Edward catalog file. We suggest that you write us for copies if you have not already received these catalogs:

Catalog 12-B
Edward
Non-Return
Valves

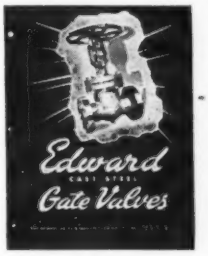


Dimensions, cross-section illustrations and descriptions for cast and forged steel non-return valves in 300 to 2500 lb sp classes. Maintenance hints, pressure drop data, pressure-temperature tables and other useful data are included.

Catalog 12-D
Edward
Blow-Off
Valves



Design detail for Edward blow-off valves with installation and operating suggestions.



Catalog 12-E
Edward
Gate Valves

Cast steel, for service from 150 to 3600 lb. Description and illustrations of the new, basically different Edward gate valve line.

NEW VALVE DEVELOPMENT

During the past year, Edward has continued its program of design improvements. Among the dozens of new developments introduced during the year, were these:

Redesigned bodies for further lowering the already remarkably low pressure drop through Edward non-return and stop valves.

The new Intex Univalve, a patented welded bonnet valve with an integral hard-faced seat, a hard-faced disk, bolted gland, bronze yoke bushing, one-piece bonnet and exceptionally low pressure drop.

Redesign of forged steel bodies of the Edward inclined stem type to reduce pressure drop through small globe valves to the point where it is comparable to flow through gate valves.

A new type of throttling valve, especially built for excessively severe service.

Pressure sealed bonnet connections for high temperature, high pressure valves.

We will be glad to give you detailed information on any of these developments which are of particular interest to you if you will drop us a line.

FUTURE PROJECTS

Edward laboratories and engineering departments have the largest backlog of new development projects in the company's history. In metals, we are working —with considerable success to date—on materials for extremely high and extremely low temperatures, so that we will be ready with valves for the several new technological processes coming which will require very high or very low operating conditions. We are continuing our extensive work in flow and pressure drop testing, incorporating our discoveries in modified designs as fast as they are proved. We are conducting research in high temperature bolting, new types of hard facing, new welding techniques, and so on. To simply list current projects takes several pages of close typing.

A NEW NAME

January 1, 1946 is a significant date in the history of this Company. On that date, The Edward Valve & Manufacturing Company, Inc., becomes, simply, Edward Valves, Inc. The old name has been recognized for the pioneering work the Company has done in steel valves, dating back to the turn of the century when the first Edward valves were built. The new name, we feel, is in keeping with the Edward product and policies, developed through the years—functional, simple, direct, up-to-date.

So, from now on, we sign ourselves as, Edward Valves, Inc.

W. F. Crawford
President

EDWARD VALVES, Inc.
EAST CHICAGO, INDIANA
A Subsidiary of Rockwell Manufacturing Company

HOW TO TEST FOR NITRATE IN BOILER WATER

By C A NOLL, *chief chemist, W H and L D Betz*

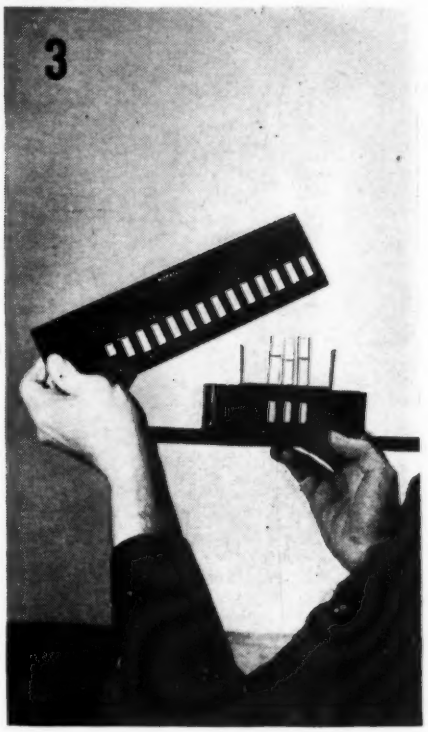
▶ RECENT RESEARCH shows that maintaining correct sodium nitrate-sodium hydroxide ratios in boiler water inhibits caustic embrittlement. Therefore determination of the nitrate ion in boiler water assumes increasing importance in power plants.

The nitrate concentration necessary to overcome embrittlement varies with water alkalinity and operating pressure. Accordingly, the sodium nitrate-sodium hydroxide ratio for each individual plant must be confirmed with an embrittlement detector. Once this ratio is established and the inhibition of embrittlement confirmed, a simple test can regulate sodium-nitrate feed.

This test is based on the development of a yellow amber color produced by the reaction of brucine reagent with the nitrate content of the water sample in a sulphuric-acid solution. Color developed is matched with a standard and the nitrate content in ppm read directly from the slide-comparator instrument.

Note: If nitrate exceeds 100 ppm discard the test. Take a 1.0-ml sample, dilute to 5 ml with distilled water and proceed as before, multiplying the observed nitrate reading by five to obtain ppm nitrate.

Photos by POWER



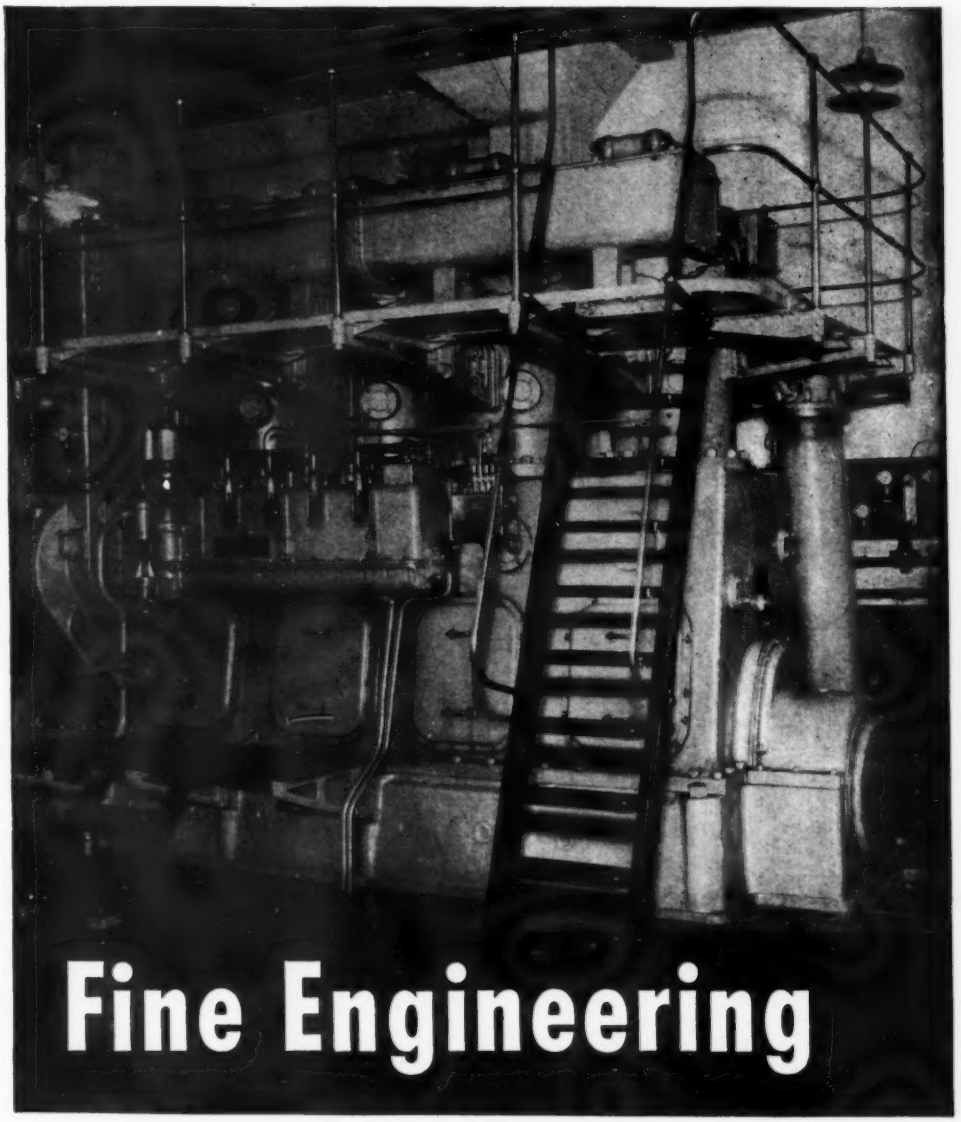
1 **Pour 5 ml of the boiler-water sample to be tested into a 100-ml beaker. Using a dropper, add exactly ten drops of brucine reagent. To mix, swirl the beaker gently to avoid spilling.**

2 **Carefully measure 10 ml of concentrated sulphuric acid and slowly add to the beaker, then mix as before. The solution will become warm. Allow to stand 5 min after adding the acid (4 min, minimum; 6 min, maximum). Then add 10 ml distilled water (or nitrate-free water) and mix. Solution may be cooled at this point if desired.**

3 **Pour 5 ml of the prepared sample into a test tube and place it in the middle compartment of a comparator base. Fill two additional tubes with distilled or clear tap water, and place one on either side of the tube containing the sample. (For most accurate results with highly colored water, fill the two outside tubes with a mixture of 5-ml of sample, 10 ml sulphuric acid and 10 ml distilled water. (Do not add the brucine reagent.) Place the nitrate comparator slide on the base and hold it toward a window. Nitrate concentration is then read from markings on the slide.**

Limitations: Test is unaffected by the ions in concentration normally encountered in boiler water. Nitrate, chloride, sulphite, phosphate, iron, alkalinity, ammonium, calcium, magnesium and silica do not interfere. High tannin concentration in excess of 800 color units causes interference, but its effect is eliminated by diluting the sample with distilled water.

Every Baldwin Diesel rests on a Foundation of Fine Engineering



What a municipal power plant needs most in a diesel engine is dependability.

Baldwin Diesels are engineered and manufacfactured with that thought in mind. Every proven new development that can contribute to complete dependability, high efficiency, and continuous trouble-free service has been included. One important modern feature is the chrome-plated liner, which multiplies liner life many times, and eliminates ring difficulties.

When you are modernizing or expanding your installation, let us tell you what Baldwin Diesels can offer in the way of plant economy and improved performance.

The Baldwin Locomotive Works, Locomotive & Ordnance Division, Philadelphia 42, Pa. Offices: Philadelphia, Chicago, St. Louis, Washington, New York, Boston, San Francisco, Houston, Cleveland, Detroit, Pittsburgh.

BALDWIN PRODUCTS

Locomotives, Hydraulic presses, Testing equipment, Steel forgings and castings, Diesel engines, Metal plate fabrication, Rolled steel rings, Bronze castings, Ship propellers, Marine steering gear, Heavy machine work, Crane wheels, Bending rolls, Plate planers, Babbitt metal, Alloy iron castings, Briquetting presses.

BLW THE BALDWIN GROUP

BALDWIN

DIESEL ENGINES

THE ARGUMENT CORNER

Breeching Air Heater Can Be Made to Work

AIR-HEATER INSTALLATION described by *JAJ* would be practical (Reader's Problems, Oct 1945). Any saving of heat in his case saves money. However, there are certain things to keep in mind.

Care should be taken that the combustion air does not exceed 300 F as temperatures above this cause increased maintenance of stoker parts. Flue-gas temperature at air-heater discharge should not go below the dewpoint. If moisture collects, sulphuric acid forms with a resultant rapid deterioration of the breeching. Flue-gas temperature of the boiler is lowest when the boiler is operating at minimum rating; therefore it is important to design the heater to work under these conditions.

I suggest the air heater be constructed as in the sketch. This heater works as a counter-flow heat exchanger because a fairly constant temperature difference between air and flue gas decreases the thermal resistance.

Sheet-steel strips are shown welded perpendicularly to the outside of the breeching. By placing these strips parallel to the air stream, pressure drop through the air heater is lowest possible. These strips will conduct the heat from the breeching and give more surface for the air to contact as it passes through the heater.

Cooling action on the exit gases will, of course, affect the natural draft of the furnace. To illustrate, assume a 100-ft chimney, 62-F atmospheric temperature, and 500-F gas temperature at base of stack before air heater is installed.

Weight of one cu ft air at 62 F = 0.0761 lb
Weight of one cu ft air at 500 F = 0.0414 lb
Difference = 0.0347 lb

Chimney will have a pressure exerted on each *square foot* at its base of 0.0347x 100 = 3.47 lb.

One sq ft of water one inch high would exert a pressure of 62.32 ÷ 12 = 5.193 lb per sq ft. The 100-ft stack shows a draft of 3.47 ÷ 5.193, or 0.67 in. water.

After installing the air heater, flue-gas temperature falls to 400 F.

Weight of one cu ft air at 62 F = 0.0761 lb
Weight of one cu ft air at 400 F = 0.0462 lb
Difference = 0.0299 lb

Pressure exerted at chimney's base is now 100x0.0299 = 2.99 lb, or our available draft is 2.99 ÷ 5.193, or 0.58 in. water. This shows that a 100-F decrease in the flue-gas temperature decreases the available draft by 0.09 in. water and therefore has affected the natural draft but boiler is not seriously affected.

Irvington, N. J. C E HICKS

Vacuum Unnecessary On Heating System

VACUUM ON THE RETURN of heating system described by *JAF* is not necessary (Reader's Problems, Sept 1945). He does not need to increase the pressure differential between radiator and return line by adding a 7-inch vacuum. Pressure of 8 psig is enough for adequate drainage through the common return line, and, if size and type of traps are correct, for voiding the system of air at startup. Present air vents can be removed because the traps are more satisfactory for removing air and gas. Since air has a density greater than steam, air pockets would have a tendency to accumulate at or near bottom of radiator.

No advantage is gained by using a vacuum return on *JAF's* system. The economy, however, is improved by draining the condensate to a receiver, from which it is pumped automatically to the feedwater heater or to the feed storage tank. The receiver can be vented to the atmosphere or, preferably, to an open feed heater. Difference in temperatures corresponding to 7-in. vacuum and the pressure in the radiator causes considerable flashing of the condensate to steam, which necessitates condensing in the vacuum-pump chamber. This cooling of the condensate decreases the plant economy since it must be again heated, using steam in the feed heater or fuel in the boilers which otherwise could be saved.

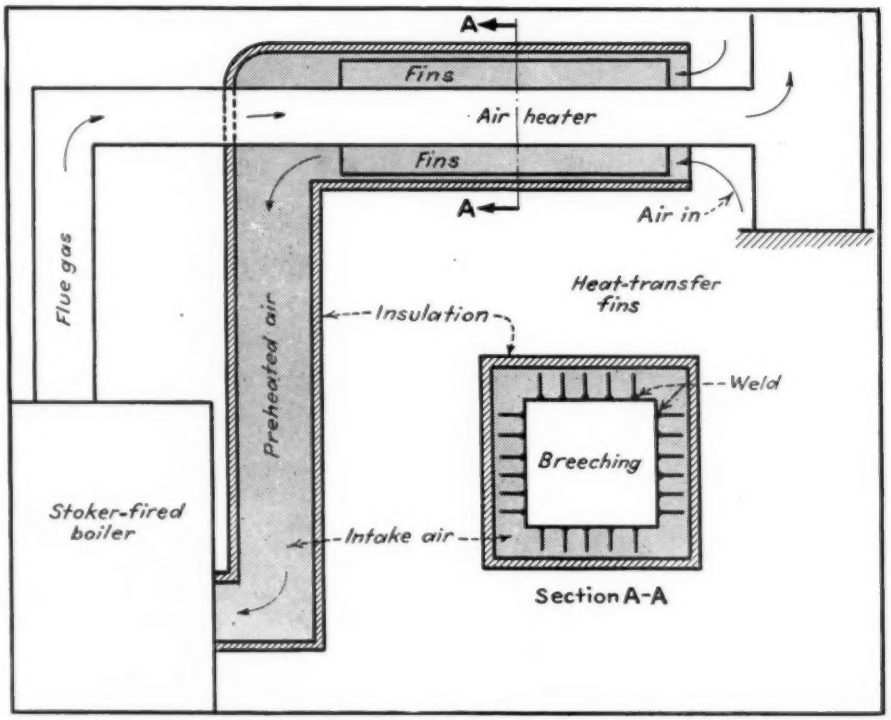
Vacuum pumps are economical on low-pressure heating systems, where the pressure is at or near atmospheric as the result of using low-pressure exhaust steam from prime movers, also on systems with low-pressure boilers where the steam pressure is often maintained below atmospheric. Here it is necessary to increase or provide the pressure differential across the trap.

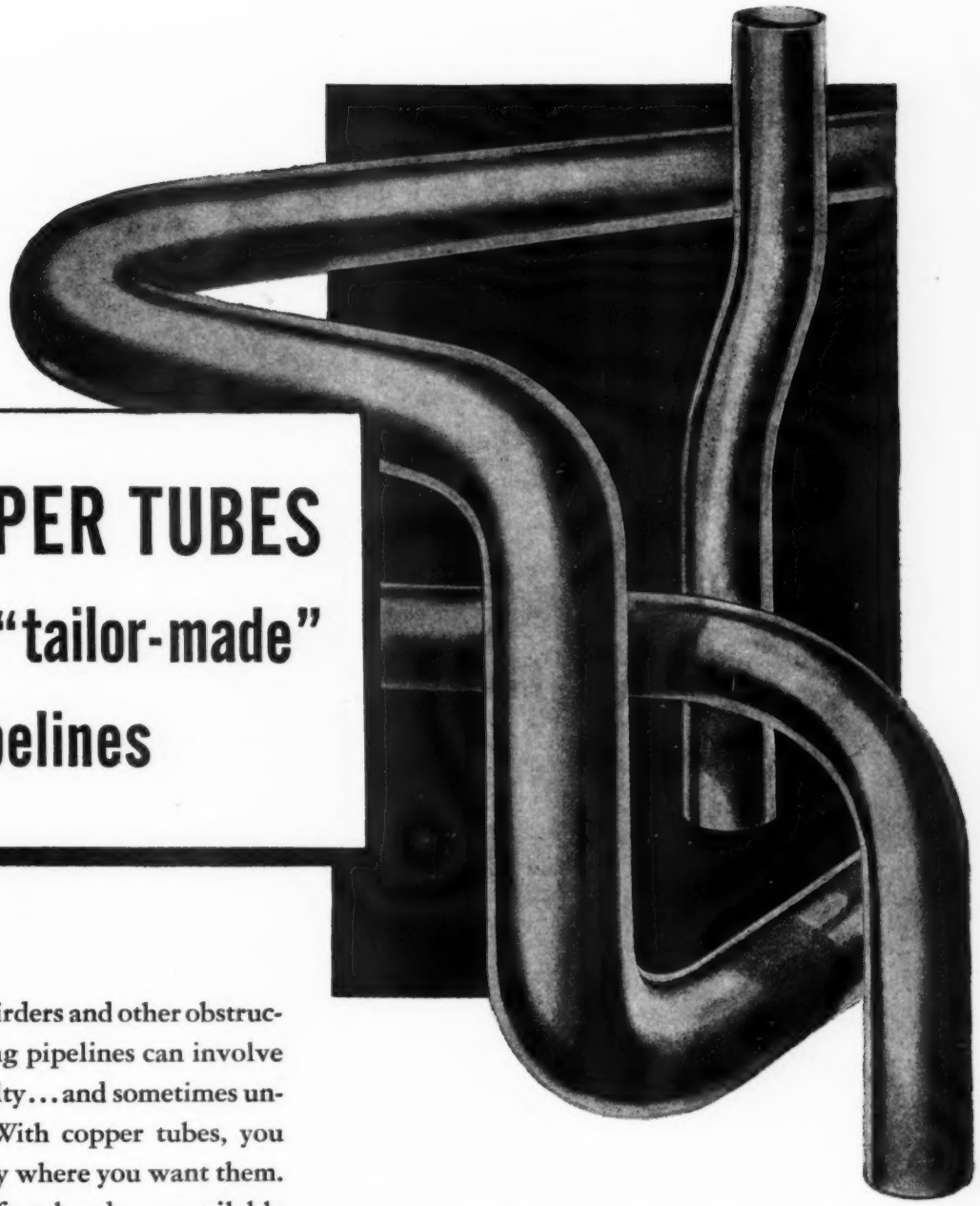
Cleveland, Ohio M E HEATH

Here's Why

O J BENSTON of Los Angeles presented a neat parlor trick (Argument Corner, Nov POWER) and asked why it

(*Continued on page* 164)





Use COPPER TUBES for those "tailor-made" Pipelines

CLEARING BEAMS, girders and other obstructions when installing pipelines can involve considerable difficulty... and sometimes unforeseen expense. With copper tubes, you can run lines exactly where you want them. Long-radius and off-set bends, unavailable in standard fittings, can be made in all sizes of copper tubes. The more generally used intermediate sizes can be bent on the job, the larger sizes machine-bent to template.

Once installed, pipelines of copper are good for years of economical service. Offering complete freedom from rust and a high degree of corrosion resistance, copper tubes retain a smooth, clean interior, provide assurance against premature pipe replacement and excessive maintenance cost.

For detailed information on Anaconda Copper Tubes, together with useful data on planning and installing pipelines, write for Publication C-24. 4870

THE AMERICAN BRASS COMPANY
General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
In Canada: ANACONDA AMERICAN BRASS LTD., *New Toronto, Ont.*

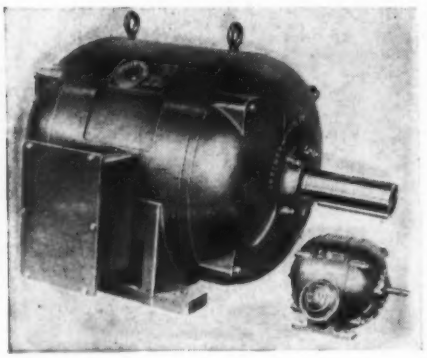
ANACONDA

Anaconda Copper Tubes

WHAT'S NEW IN PLANT EQUIPMENT

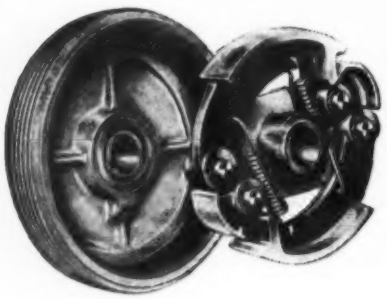
AC Motors

SQUIRREL-CAGE AC MOTORS up to 200 hp now constitute this line of *Protected Type*, full-load continuous-duty units. Rated for 40-C rise, 15% service-factor, all rotors are insulated with *Vinylastic*, with smaller ones of single cast-aluminum structure. Ball-bearing units come with patented centrifugal bearing seal. **Crocker-Wheeler Div, Joshua Hendy Iron Works, Ampere, N. J.**



Pole Setting

LABOR-SAVING QUICK-ACTING EARTH-BORING DRILL, it is claimed, prepares an average of 20 pole holes a day. *Ka-Mo Drill* draws power from a 4000-watt *OFA-2* generator to operate windlass that extracts earth auger after it has bored to required depth. Drill extensions, or coupling rods to the prime section, permit 12-ft holes to be dug. Pole-holes need 12- to 15-in. drills; anchor holes, 9-in. augers. **D W Onan & Sons, 43 Royalston N, Minneapolis 1, Minn.**



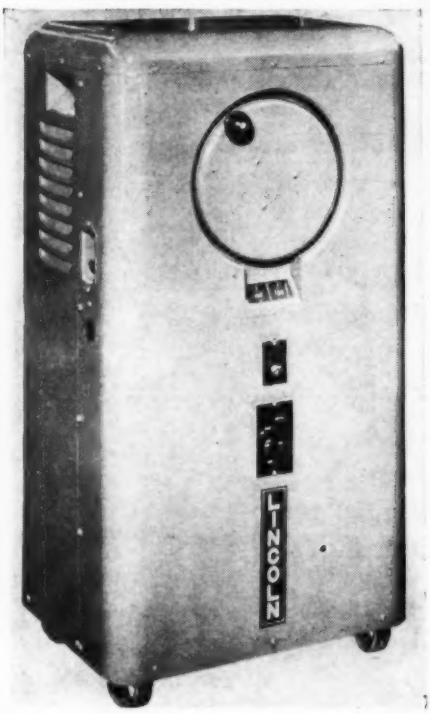
Automatic Clutch

SHAFT-ATTACHED, CENTRIFUGALLY OPERATED clutch offers fluid-drive advantages, it is claimed, with no slippage and complete disengagement when idle. Opposed expansion shoes, dual-spring balanced, press outwardly with rpm increase beyond stipulated point and contact friction drum. Available in two models, fractional to 3 hp, and up to 6 hp, unit operates with different drives mounted on the shaft. **Salsbury Motors, Inc, 4464 District Blvd, Los Angeles 11, Calif.**

Portable Welder

LIMITED-INPUT SINGLE-PHASE 230-v welder meets REA and rural requirements for use with normal 3-kva transformer. *Fleet-Arc Jr* draws a maximum input current of 35 amp with welding duty from 20 amp at 20 v to 180 amp at 25 v. It handles electrodes from $\frac{1}{8}$ to $\frac{5}{32}$ in. dia.

Welder employs *Arc Booster* principle which, it is claimed, provides quick, easy starting. When electrode touches the work,



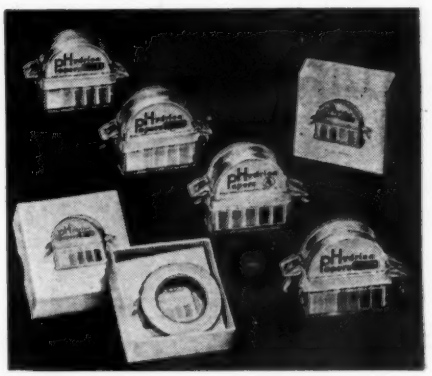
welding current undergoes a boost in intensity, establishing an arc. Once it is established current reverts to preset amount for job at hand. Snap switch selects one of two arc-booster ranges. Hand wheel varies current reactor over welding duty range from 20 to 180 amp. **Lincoln Electric Co, Cleveland 1, O.**

Soapless Cleaner

ABRASIVE-FREE, COMPLETELY SOLUBLE, powdered cleaner cuts away grease and grime, manufacturer claims. Every ingredient serves as an active, useful detergent. Heavy-steel industry, it is reported, found that *KP* cleaned castings and grease-coated machinery more effectively than acid. **K P Chemical Co, 16 W 46th St, New York 19, New York.**

Air Duct

FLEXIBLE HEATING AND VENTILATING DUCT displays high-insulation qualities. Manufacturer further claims that *Airtron*, made of glass cloth and rubber, withstands temperatures from —60 to +300 F, and pressures up to 50-psi internal pressure at all temperatures. Tube comes in 1- and 6-in. dia of any desired length. Its reported qualities of resistance to air, light, water, gasoline, oil, and all but concentrated acids combine with its flexibility to fit installations exposed to vibration and weather. **Arrowhead Rubber Co, Dept A-15, 2244 E 37th St, Los Angeles 11, Calif.**



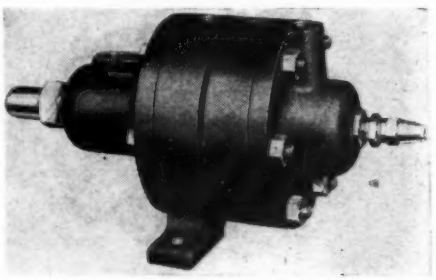
Papers Test pH

RAPID, APPROXIMATE pH TESTS made possible within an accuracy of 0.25 pH by use of six papers covering range from 1 to 14 pH. Transparent-plastic dispenser holds two papers in roll forms. **R P Cargille, 118 Liberty St, New York 6, N. Y.**

Pneumatic Relay

VERSATILE, PILOT-OPERATED, sensitive, pneumatic relay performs different operations depending upon application of loading pressures to various diaphragms. *Type F Totalizer* works from compressed air at a substantially constant pressure. At maximum output-loading pressure, a change in incoming loading of as little as 0.1% effects a reproducible change in output pressure.

Totalizer may be used as an element in a control system to: (1) add or subtract loading pressures, thereby totalizing various



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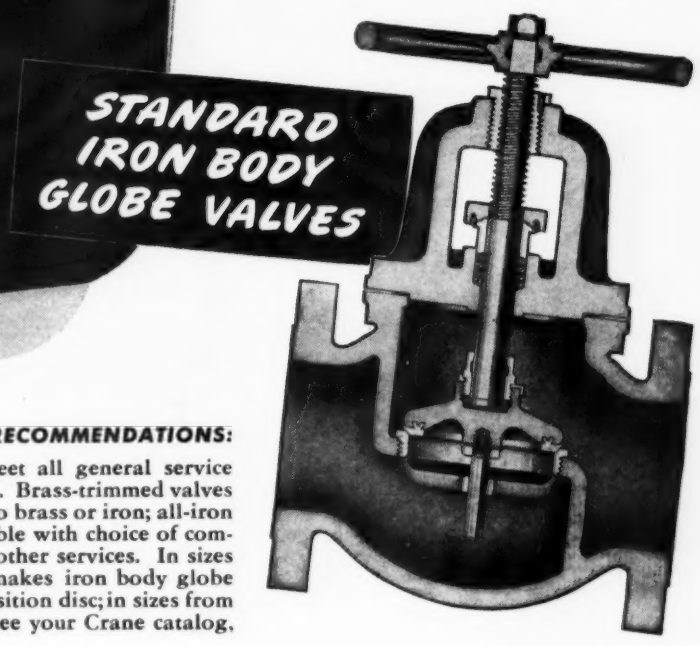
Piping to heat exchanger

Piping systems operate under varying conditions. What conditions should dictate your choice of piping materials, you can best determine. Then Crane helps you meet those specific requirements with the world's largest line of valves, fittings, pipe and piping accessories for all applications. By demonstrating the merits of all types of materials, Crane, with 90 years' experience, enables you to choose correctly for every need.

Ordering from the Crane line simplifies all piping jobs. Your Crane branch or Wholesaler supplies all materials. You're sure to get a better installation and better performance with all parts of uniform quality, backed by single responsibility. This *complete* Crane service is *made-to-order* for your peacetime program.



SERVICE RECOMMENDATIONS:

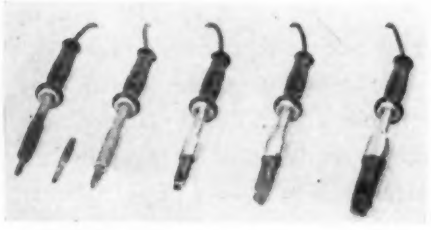
Crane Standard Iron Body Globe and Angle Valves meet all general service requirements with working pressures up to 125 pounds steam. Brass-trimmed valves are recommended for steam, water, and fluids non-corrosive to brass or iron; all-iron valves for fluids that corrode brass but not iron. Also available with choice of composition discs for steam, hot water, cold water, air, oil, and other services. In sizes from 2 in. up—with screwed or flanged ends. Crane also makes iron body globe and angle valves in all-iron; with brass trim; and with composition disc; in sizes from ¼ to 2 in. Rated at 150 pounds steam, 250 pounds cold. See your Crane catalog, pages 143 to 151.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE

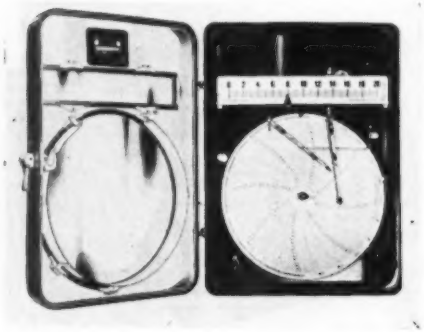
VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

fuels fired in a multiple-fuel system (2) average two or more loading pressures indicating air requirements for a group of burners or pulverizers (3) select loading ratios thereby controlling fan speed on basis of air requirements for heavily loaded burners (4) respond to a sequence of loading pressures determining different burners or fans (5) produce anticipating or derivative action to overcome storage effects in certain control applications (6) serve as a safety relay to limit firing rates or act as a pneumatic stop for diaphragm-operated valves and (8) invert load pressures to produce a pressure moving in a direction counter to that producing it. **Hagan Corp, Hagan Bldg, Pittsburgh, Pa.**



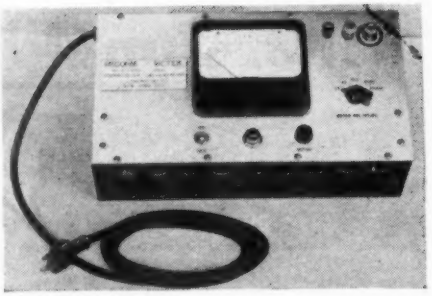
Soldering Iron

FAST, CONTINUOUS, HIGH-QUALITY SOLDERING requires irons with quick recovery and high reserve-heat capacity. New line, ranging from 75- to 300-watts rating, tips, of ⅜ to 1¼ in. dia, meet requirements, manufacturer claims, with calorized copper and 18-8 stainless steel for all parts subject to high temperature. *Calrod* heating unit is reputed to assure long life, uniform performance as well as convenient renewal. Irons come with calorized copper tips and also iron-clad copper tips to prevent amalgamation with the tin in solder. **General Electric Co, Schenectady, N. Y.**



Electric Controller

PROPORTIONAL INPUT, ACCURATE CONTROL, recorded data constitute features of an on-and-off electrically operated control. Designed for electrically heated furnaces, control depends upon a rotating cam to interrupt current to heating coils whenever temperature exceeds control point. **Bristol Co, Waterbury, Conn.**

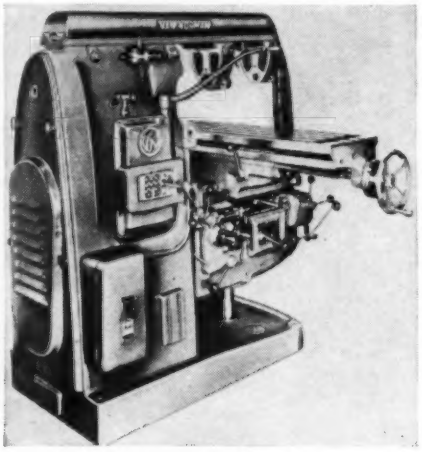


Megohm Meter

STABLE SINGLE-SCALE 4-in. meter operates over four range-settings covering from 400,000 ohms to 100,000 megohms. Operating on 115 v, 60 cycles, this 1500-megohm meter is accurate, claims its manufacturer, to within 5%. Portable 8-lb model. **Communications Measurement Laboratory, 120 Greenwich St, New York 6, N. Y.**

Screw Pump

BALANCED, QUADRUPLICATE SCREW PUMP incorporates advantages of new external-bearing pump with anti-friction thrust and line bearings. Precision preloaded anti-friction bearings permit, manufacturer states, close running clearance between body bores and screws. It is further claimed that new construction can be fitted into existing pumps without disturbing present piping. **Quimby Pump Div, H K Porter Co, Oliver Bldg, Pittsburgh, Pa.**



Milling Machine

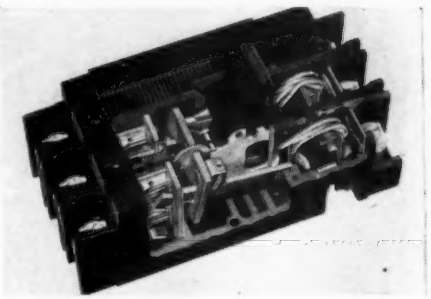
COMPACT, HEAVY-DUTY, DEPENDABLE MILLER operates with sensitive control and accuracy, manufacturer states. New transmission includes heavy large-diameter flywheel, spindle-mounted to aid smooth power application to cutter. Pilot wheel provides ready positioning of overarm. Ease of control depends on built-in directional controls, as well as hand feeds for lining-up work.

No. 3 *Standard* normal milling machine specifications are: table 64x14 in., drive motor 7½ hp, 18 speeds from 25 to 1250 rpm, 18 feeds from ⅜ to 32 in., longitudinal table travel 34 in., saddle cross feed 12 in., knee vertical feed 17 in. **Van Norman Co, Springfield 7, Mass.**

Machine Levelers

RUBBER-INSULATED DUAL-PURPOSE vibration mountings support equipment at desired levels with reduced vibration difficulties. Synthetic rubber-insulating material separates an outer shell, the base of the mounting, from an inner cylindrical member to which a stud is fastened.

Two nuts serve as leveling device: One adjusts to desired level and the other locks at the selected point. Zee and angle brackets, supplied separately, allow existing machinery to be maintained at present level without cutting the floor for *Vibro-Levelers*. **Bushings Inc, Coolidge Highway at 14 Mile Rd, Royal Oak, Mich.**

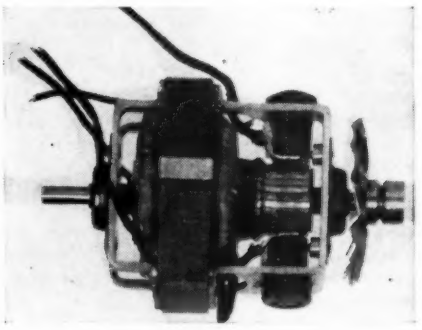


Circuit Breaker

WEATHERPROOF, DUST-TIGHT explosion-resisting sheet-steel inclosures house the *ML2* 100-amp frame circuit breaker. Device comes in 15 to 100 amp, 600-v ac and 50 to 100 amp 250-v ac or dc; 2 and 3 pole. Similar breakers with front-operating handle for 3- and 4-wire solid neutral applications and separate units for panelboards are available. **Square D Co, 6060 Rivard St, Detroit**

Steam Humidifiers

STEAM-OPERATED VENTURI-NOZZLE HUMIDIFIER assures thorough air and vapor mixture, manufacturer asserts. Models come with valves (1) solenoid operated to control steam discharge or (2) hand operated to give manual control. **Armstrong Machine Works, Three Rivers, Mich.**

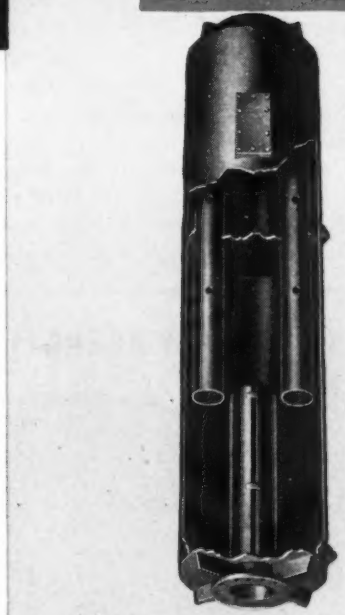


Fractional Motors

OPEN-LAMINATED CONSTRUCTION and 10-bladed fan aid cooling of continuous-duty fractional-hp motors. *V-series*, 125-v ac or dc, 7500 rpm, operate nonreversing, have

(*Continued on page* 174)

KILL ENGINE EXHAUST NOISE WITH MAXIM SILENCERS



Maxim Exhaust & Intake Silencers silence the exhaust or intake of internal combustion engines, steam engine exhaust, compressor intake, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type. Spark arresting included where necessary.

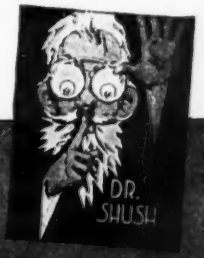
Adequate silencing of engine exhaust noise is an operating necessity today. The engines shown above could, without proper silencing, make a public disturbance that would quickly be felt by those in charge of plant operation. With Maxim Silencers, however, exhaust noise can be reduced to a point where it is scarcely audible.

Maxim engineers will be glad to recommend the correct silencing equipment to best meet your particular problem. Send your specifications to the address given below.

Maxim also makes Heat Recovery Silencers which combine efficient silencing, spark arresting, and the recovery of waste exhaust heat to produce steam or hot water for heating or processing operations. These are described in Heat Recovery Bulletins WH 100, WH 101 and WH 103.

WRITE FOR BULLETINS describing exhaust & intake silencers D 125, D 127, D 101, D 37.

THE MAXIM SILENCER CO. 92 HOMESTEAD AVE., HARTFORD, CONN.



ARMY E NAVY

MAXIM

POWER NEWS

BUSINESS ITEMS AND APPOINTMENTS • WASHINGTON NOTES

FOREIGN FIELDS • MODERNIZATION • FUEL CONSERVATION

Announce Midwest Power Conference

▶ ILLINOIS INSTITUTE OF TECHNOLOGY, sponsors of the Midwest Power Conference, announce through the conference chairman, Stanton E Winston, that annual meetings will be renewed beginning April 1946.

Government regulations forced the cancellation of the 1945 meeting. In scheduling renewal of the conference, annually the largest meeting of its kind in the nation, three full days, April 3, 4 and 5, have been selected. With relaxation of military security, so many recent and important developments in the power field have come to light that this time extension is felt advisable.

Preliminary plans include for the first time a session on gas turbines in view of the increasing importance this medium of power transfer has assumed through its many wartime applications. Atomic energy and its position in the postwar world is similarly scheduled for discussion.

To date plans call for presentation of papers on industrial power plants, hydro power, feedwater treatment, recent developments in heating and air conditioning, fuels and combustion, central station practice, industrial-load supply, diesel power, insulation problems on power systems, and the aforementioned recent developments.

Joint luncheons with American Society of Mechanical Engineers and American Institute provide highlights of the meeting, which will culminate with an "All Engineers Dinner."

Professor Winston, director of the evening division of Illinois Institute of Technology, assumes his role as conference director for the seventh consecutive time. C A Nash, associate professor of electrical engineering at Illinois Tech, assists as conference secretary.

Cooperating with Illinois Institute under Winston's direction are nine Midwestern colleges and universities and eight engineering groups from this same section of the country.

Educational institutes under this arrangement comprise universities of Illinois, Michigan, Minnesota, Wisconsin, Iowa State, Northwestern and Purdue, as well as the two colleges of Iowa State and Michigan State.

These engineering groups are cooperating: Chicago sections, AICHE, AIEE, AIME, ASME; Illinois section, ASCE; Illinois chapter, ASHVE; also the Western Society of Engineers and the Engineers' Society of Milwaukee, in Wisconsin are contributing their support.

Public Power Requests Undergo Heavy Cutbacks

Severe cuts in funds for public power projects feature the House Appropriations Committee report on the first deficiency appropriation bill. Specifically singled out for admonition has been transmission line construction.

One basic point of difference between public power enthusiasts and private enterprise supporters receives committee attention. That point, the policy of energy sale, at the busbar of federally generated power is illustrated by this excerpt.

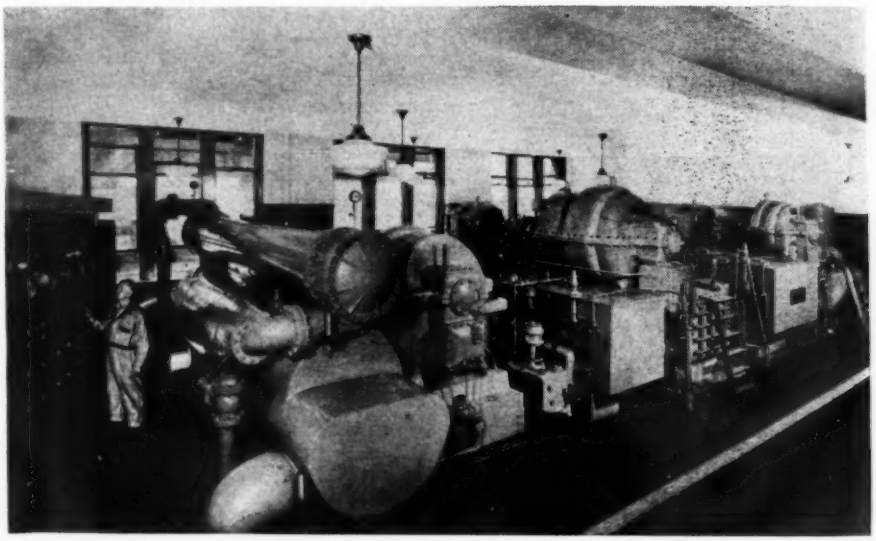
"In connection with the denial of funds ($515,000) for power market and transmission line studies and surveys, the committee has taken the position that the government should not go into the business of constructing transmission lines to market power developed at government dams and that the activity desirous of securing such power should construct such lines to the point where government power is being generated."

While recommendations and cuts of transmission line funds were generally far short of public power exponent's expectations, this in no way indicates a trend toward reversal of policy. From previous experience the House public power bloc, spearheaded by an aggressive California delegation, can be expected to make a concerted effort to restore all cuts and put the House on record against its committee's power policy sentiments.

One committee recommendation for a slash of funds, allocated for California's Central Valley project, from $24,500,000

(*Continued on page* 190)

COMPRESSORS IN SHOWROOM OPERATION



Three centrifugal refrigerating compressors occupy space in former sales office of Peerless automobiles. These compressors serve Carling's Brewery in Cleveland where Brewing Corporation of America plans to double its million-barrel capacity in what was once the old Peerless automobile plant. Cooling output of these units amounts to 800 tons, enough to melt an acre of ice 7 in. thick every day. Additional compressors will occupy the other half of this 50x50-ft room

sure Joe*...

NALCO Has a Chemical that Will Keep Scale and Scum Out of Compressor Water Jackets

but... it is the whole Nalco system of water treating that does the job. Cleaning scale and scum from the inside of the water jackets of horizontal compressors is not an easy job. It is much better to prevent it from forming in the first place.

You would not attempt to build a house with just a hammer . . . it takes many tools and a thorough knowledge of construction. So it is with water treatment, Joe—it takes more than just one chemical. Your water service engineer needs to have available a wide range of water treating chemicals to choose from, *plus* a complete follow-through program to solve the various water treating problems throughout industry. *Nalco provides this!*

Ask for a Nalco survey today.

Says
Grant Sievertsen
Nalco Representative,
Knoxville, Tennessee

Photo in Nalco Laboratories

* Chief Engineer Joe, says—*Even with a "hand hole" on each side of the water jacket it is still difficult to clean out the scale and scum. We were wondering if anyone had a chemical which would keep scale and scum out of the jacket.*

Source: Survey conducted by a well-known power publication.

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to
Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto, Ontario

Nalco — System of Scientific Water Treating Service . . . for all industry

How to plan

FUEL OIL STORAGE CONNECTIONS WITH HEATING COIL

Another in the series of basic Piping Layouts prepared by Jenkins Bros.

Heated Tanks must be provided for the storage of industrial heating oil in most plants using this fuel for boiler furnaces generating heat or power, or for processing furnaces.

To Assure Uninterrupted Service when cleaning, or in event of a breakdown of one of the systems, a duplicate installation of tanks is shown in this layout. Since circulation must be provided to keep the oil fluid, a return line as well as a suction line from the tanks is shown. A valve is provided to control the amount of oil from the return line that recirculates directly to the suction line. Connections are provided for both high and low suction. High suction guards against difficulties from sediment, while the low suction is necessary when the fuel oil supply is extremely low.

The Free Blow shown on the steam line connections to the heating coils in the tank is important for testing for the presence of oil in the steam return line, since oil would indicate a leak.

Extra Heavy Globe Valves of the regrind-renew type are recommended on the oil lines to insure maximum safety in the transmission of hazardous fluid, and to meet code requirements. Valves indicated on the steam lines in the layout are for 200 pounds steam service, but the Jenkins Catalog lists a complete line for any pressures required. Outside Screw and Yoke Gate Valves are suggested because they show at a glance if the valve is opened or closed.

Jenkins PRACTICAL PIPING LAYOUTS

Illustrating the proved 3-point formula for trouble-free, time-defying hookups

1. **Place valves correctly in the line.**
2. **Use the right type valve for the service.**
3. **Choose Jenkins Valves for lifetime economy.**

6

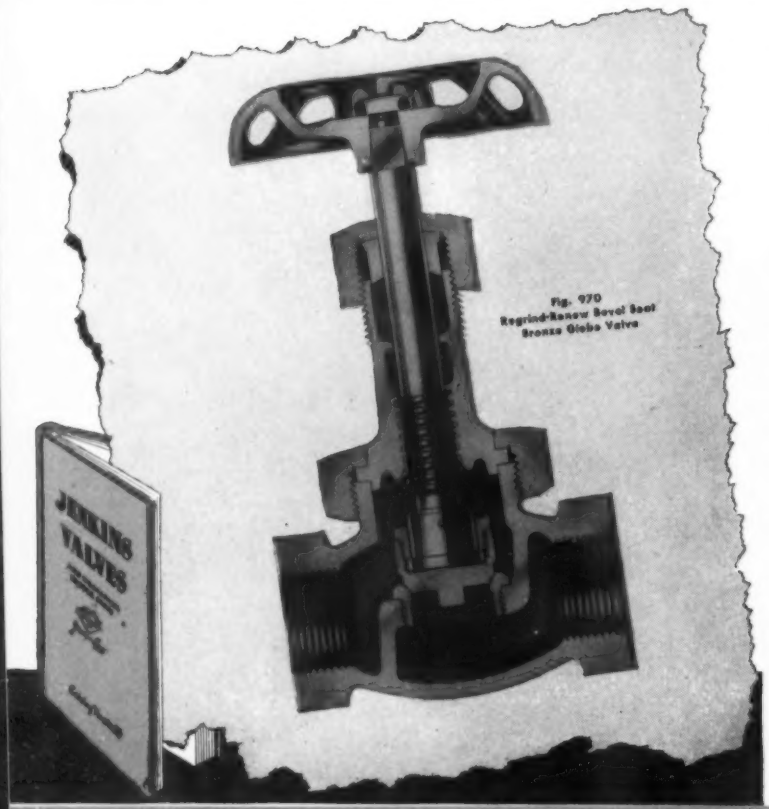


Fig. 970
Regrind-Renew Bevel Seat Bronze Globe Valve

Many Types and Pressure Ranges of Jenkins Valves other than those shown can be used for this type of layout, according to the factors involved. Consultation with accredited piping engineers and contractors is recommended when adapting these suggestions to your own requirements, or when planning any major piping installations.

Copies of Layout No. 6 will be furnished on request by Jenkins' Engineers . . . also copies of future Piping Layouts. Just fill out and send the coupon.

Fig. 970, a Regrind-Renew Bevel Seat Bronze Globe Valve, is used on the oil lines in this layout. It is of exceptionally heavy construction, designed for use where service conditions are severe, where tightness is essential, and where operation is frequent. The regrind-renew feature makes it easy to recondition, when required, to assure long, trouble-free performance.

CHOOSE FROM OVER 600 JENKINS VALVES

To save time, to simplify planning, to get the advantage of Jenkins specialized valve-engineering experience, – select all the valves you need from the Jenkins line, fully described in the latest Jenkins catalog, No. 76. It's your best assurance of the *lowest cost in the long run.*

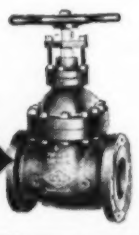
Jenkins Bros., 80 White Street, New York 13; Bridgeport, Conn.; Atlanta, Boston, Philadelphia, Chicago, San Francisco. Jenkins Bros., Ltd., Montreal, London.

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864

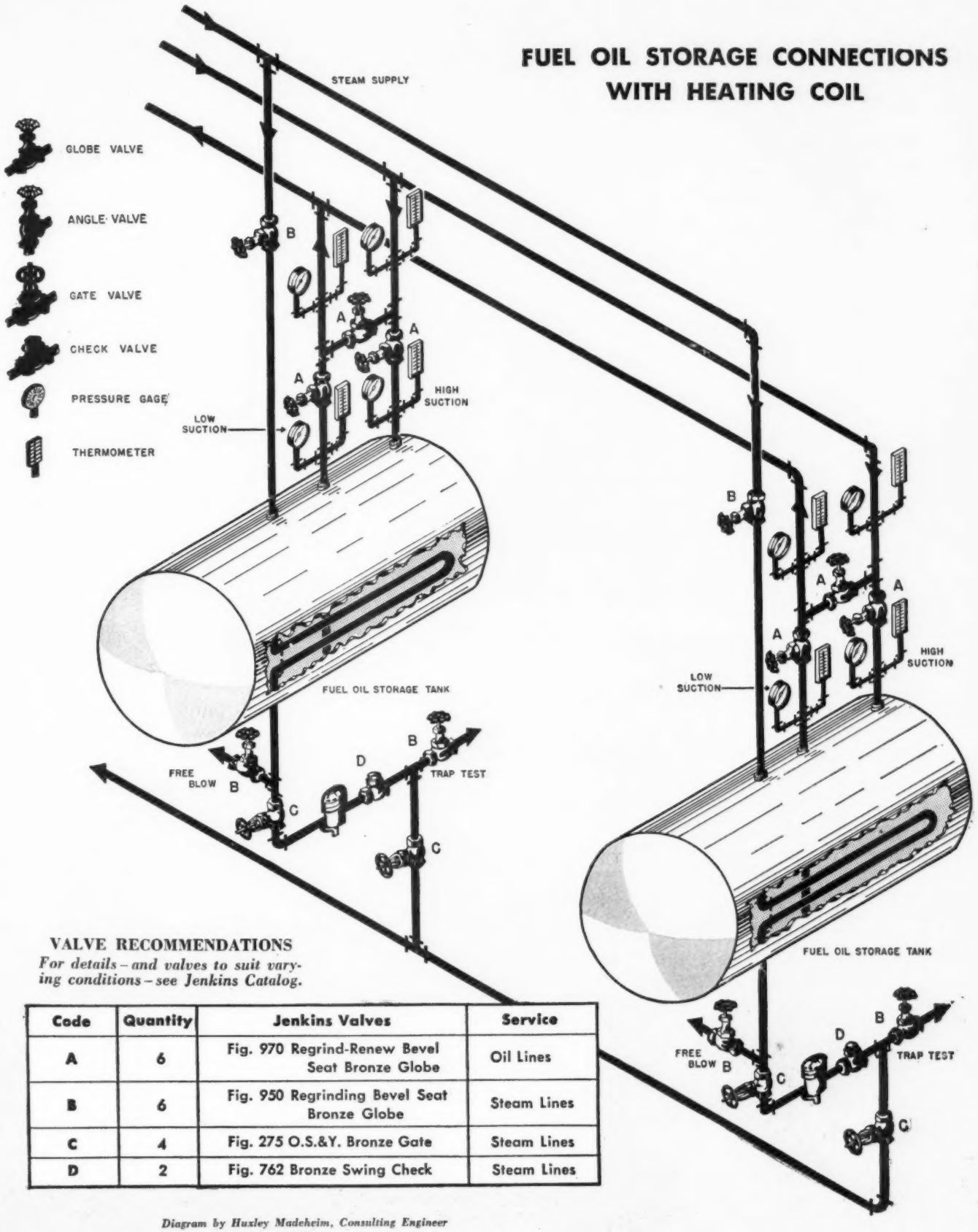
TRADE JENKINS MARK



125 TO 600 LBS. PRESSURE

Jenkins Bros

FUEL OIL STORAGE CONNECTIONS WITH HEATING COIL



VALVE RECOMMENDATIONS

For details – and valves to suit varying conditions – see Jenkins Catalog.

Code	Quantity	Jenkins Valves	Service
A	6	Fig. 970 Regrind-Renew Bevel Seat Bronze Globe	Oil Lines
B	6	Fig. 950 Regrinding Bevel Seat Bronze Globe	Steam Lines
C	4	Fig. 275 O.S.&Y. Bronze Gate	Steam Lines
D	2	Fig. 762 Bronze Swing Check	Steam Lines

Diagram by Huxley Madeheim, Consulting Engineer

BRONZE ★ IRON ★ STEEL

FOR EVERY INDUSTRIAL, ENGINEERING, MARINE, PLUMBING–HEATING SERVICE

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JENKINS BROS., 80 White St., New York 13, N. Y.

Please send me a reprint of Piping Layout No. 6, and future Layouts as they become available.

Name .....

Company .....

Address .....

Number 161

Steam-Turbine Size Factor

► TURBINE SIZE FACTOR is a convenient measure of the inlet size of a steam turbine. It is useful in obtaining quick estimates of capacity for turbines designed for one set of steam conditions but operating at another. It may be used to give an equivalent size indication of a turbine for abnormal steam conditions.

The chart shown below and the following four examples describe typical uses:

Example 1: Find the maximum capacity of a turbine rated at 2000 kw with maximum capacity of 2500 kw designed for 400-psig throttle pressure and 1-in.-Hg-abs exhaust pressure when the throttle pressure is reduced to 200 psig.

Maximum capacity at new conditions = maximum capacity at design conditions $\times \frac{\text{size factor at design conditions}}{\text{size factor at new conditions}} =$

$2500 \times (11.2/22.4) = 1250$ kw

Example 2: Find the maximum capacity of a turbine rated at 2000 kw with maximum capacity of 2500 kw designed for 400-psig throttle pressure and 40-psig exhaust pressure when the throttle pressure is reduced to 200 psig.

Maximum capacity at 200 psig =

$2500 \times (27.5/73.0) = 943$ kw

Constant engine efficiency has been assumed in the above examples resulting in only a small error. For the noncondensing unit it is probable that the efficiency would fall off somewhat and the reduction in throttle pressure would further decrease capacity because of smaller pressure differential.

When changing exhaust conditions from condensing to noncondensing apply a correction factor of about 0.7.

Example 3: For the turbine in Example 1 find maximum capacity when exhaust pressure is increased to 0 psig.

Maximum capacity at 400-psig throttle and 0-psig exhaust =

$2500 \times (11.2/18.7) \times 0.7 = 1050$ kw

Instead of finding changes in capacity of a given turbine the approximate size of a turbine for unusual steam conditions can be visualized in terms of a more conventional unit.

Example 4: Find the equivalent physical size of a 5000-kw turbine designed for 150-psig initial and 60-psig exhaust pressures compared to a unit designed for 400-psig throttle and 2-in.-Hg exhaust pressures.

Equivalent rating at 400-psig throttle and 2-in.-Hg exhaust =

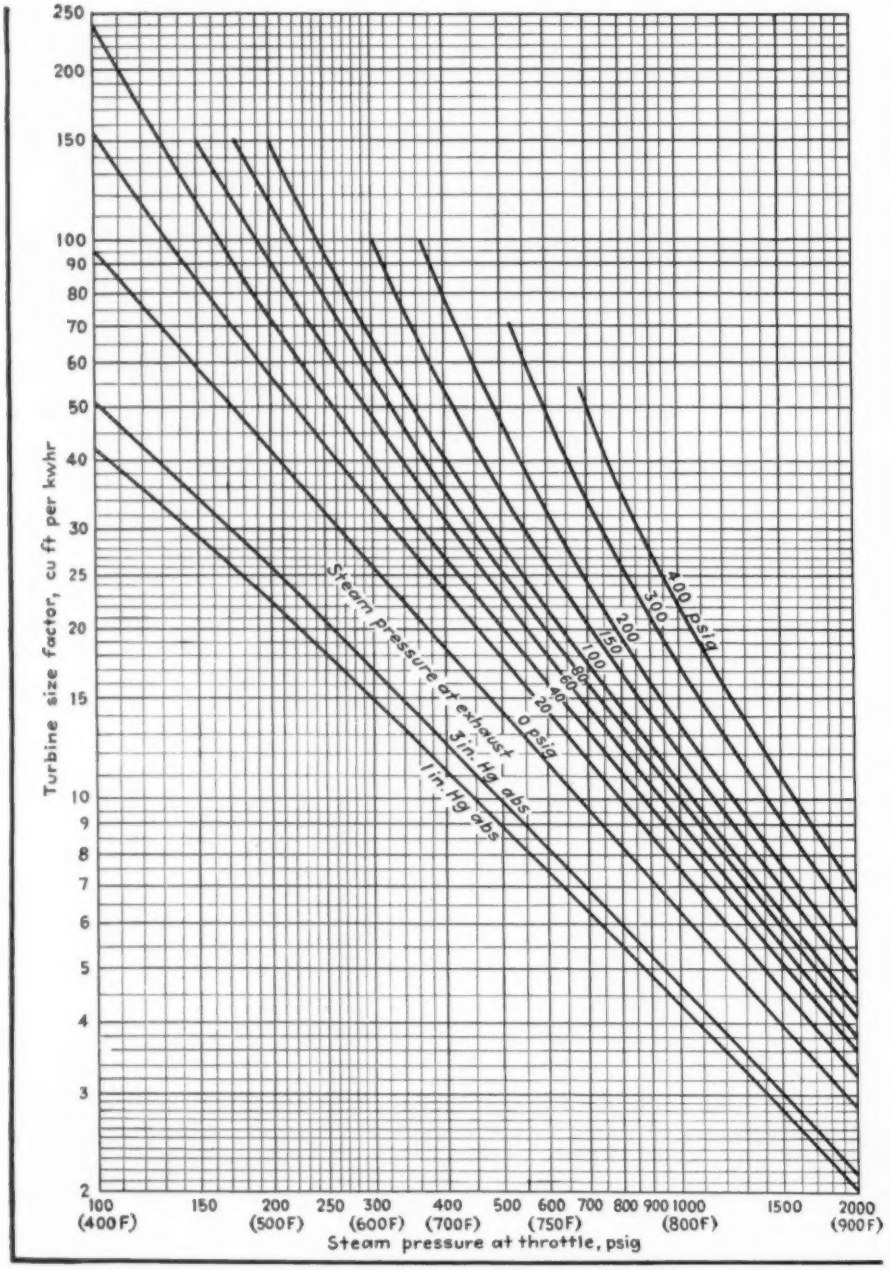
$5000 \times (150/11.8) = 63{,}500$ kw

This turbine will have a high unit cost per kw of capacity because of the large steam flow required to develop a relatively small output.

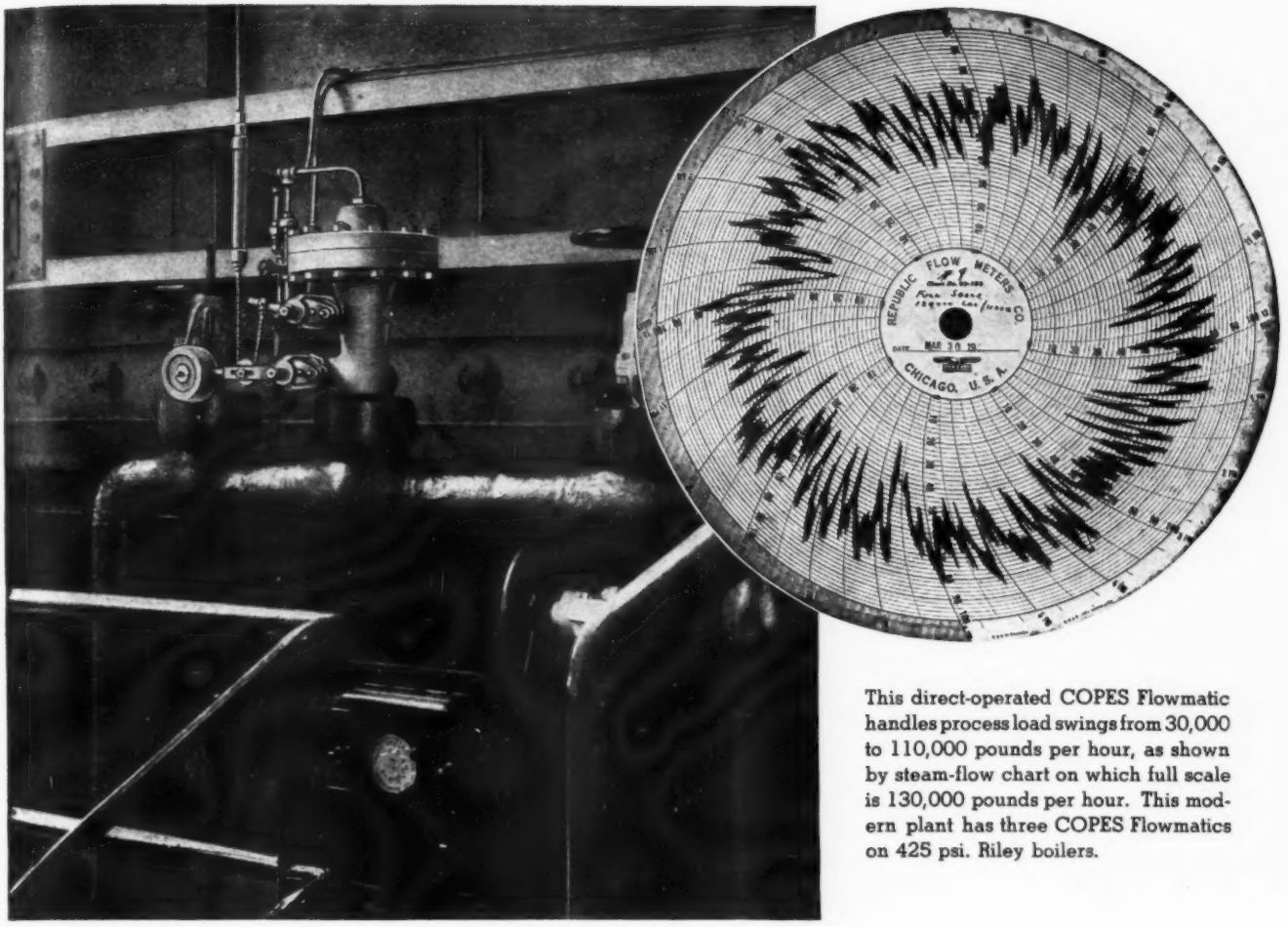
Size factor is normally used only as a ratio so the fact that it is expressed in cu ft of throttle flow per kwhr is of little importance. The chart was derived simply by multiplying theoretical steam rate (lb per kwhr) by the steam's inlet specific volume (cu ft per lb).

Without consulting the manufacturer of an existing turbine, do not act upon estimates that would overload the unit or operate it at pressures or temperatures in excess of its design limitations.

By L E Newman, General Electric Co



© POWER



This direct-operated COPES Flowmatic handles process load swings from 30,000 to 110,000 pounds per hour, as shown by steam-flow chart on which full scale is 130,000 pounds per hour. This modern plant has three COPES Flowmatics on 425 psi. Riley boilers.

On *fluctuating* process loads

As the Plant Engineer expressed it: "It would be foolish to claim the water level is held constant on these rapid changes, for *no* regulator will take water away from a boiler when the sudden load comes on, as it would have to do to hold the level constant. The normal water level is at the center of the drum. As the load hits, expansion of the boiler water along with increase in gas fuel supply (combustion and pressure control) on a slight drop in boiler pressure again increases the volume of the water-steam content of the boiler and raises the level three or four inches, and will do this with no feed. This higher level is held until the stored water is used up. On a drop in load and rise in boiler pressure, the level is held constant."

No matter how severe your loads—process or power, —COPES Flowmatic assures an always-safe boiler water level. Bulletin 429-A tells how and why. Write for it—your letterhead, please.

NORTHERN EQUIPMENT COMPANY
161 GROVE DRIVE, ERIE, PENNSYLVANIA
Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters
BRANCH PLANTS: Canada, England, France
Representatives Everywhere

★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR
FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

Our Need . . .

"Every baby is a scientist who learns by research, and keeps on being a scientist until he reaches the age of six or eight. Then he goes to school and is told certain things are true because a book says so. By the time he finishes his formal education he's been drilled so in believing the things other people say are true that, except in a few cases, all his scientific approach is gone."

Thus a speaker recently explained why, in this dawning Age of Science, so few men are scientists. He went on to urge an organized program for increasing their number, but he offered no suggestions for controlling the problems that result from the developments that science has already brought us.

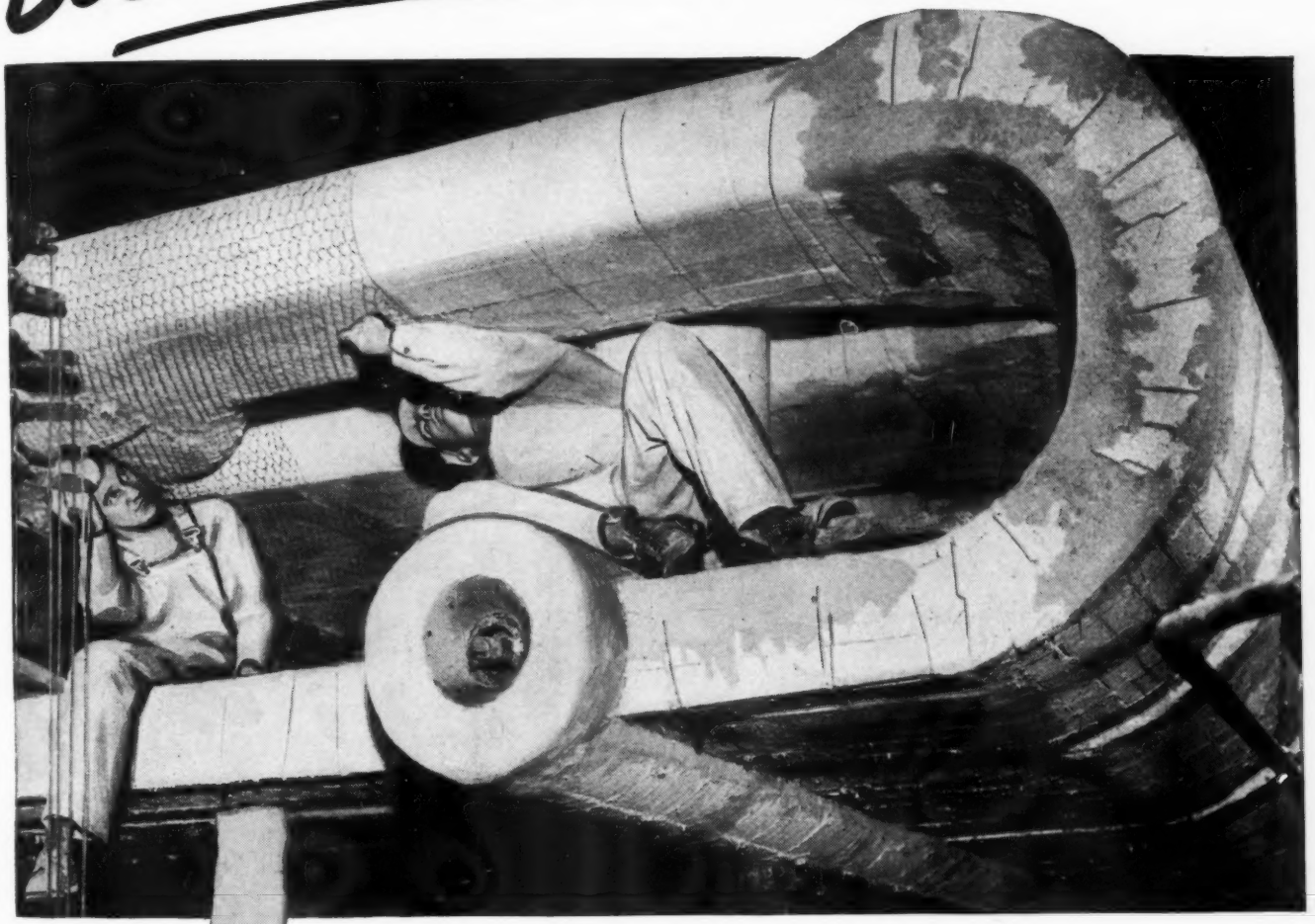
Long before the war, there were evidences that our mechanical civilization had developed more rapidly than our ability to absorb it. A few seers worried about it, particularly after the panzer divisions began to roll. But the rest of us confined our worries to the effect of comic books on our innocent children. We frequently explained to them that superhuman abilities and superlethal weapons could exist only in the fertile imaginations of the cartoonists. We kept right on explaining how impossible they were—until the first atomic bomb removed Hiroshima from the face of Japan.

Suddenly, the mad extravagances of the comic books were reality. Nuclear fission was only the first of these revelations. Now we know of gun directing and airplane landing by radar, navigation aids that are independent of cloud or storm, shells that explode when they sense a target, bombs that can be sent on their deadly way alone and directed by television. We learn, too, of the "impossible" achievements that brought these things into being—of the fact that now 10,000 men can produce as much rubber as 9,000,000 men did a few short years ago. The comic books are tame beside such tales.

The world needs more scientists to convert our weapons into tools, it's true. But more importantly, it needs men with the vision and the sanity to plan our future so we do not destroy ourselves. Scientists are apparently developed by encouraging men to keep the inquiring minds of little children. But by what method can we evolve sane leaders of men? Our world has more need of them now than ever before.

George Edwards
Engineer

Bosses of the Btu . . .



Tight fits in tight spots . . . another investment in J-M Insulations that is destined to pay off as planned.

. . . their skill is your protection against the pitfalls of poorly applied insulation

PITFALLS in insulation application are many —and costly. Costly in money through wasted fuel . . . costly in operating efficiency through inadequate heat control.

To assure proper application of its insulating materials, Johns-Manville recommends the engineering skill and expert workmanship of organizations especially set up for this work. In some areas the groups are Johns-Manville's own construction forces. In others, they are J-M Technical Service Units—contracting companies carefully selected for their integrity and background in this field. Each of these organizations is responsible for handling all details of an insulation job—a complete carry-through from planning to application.

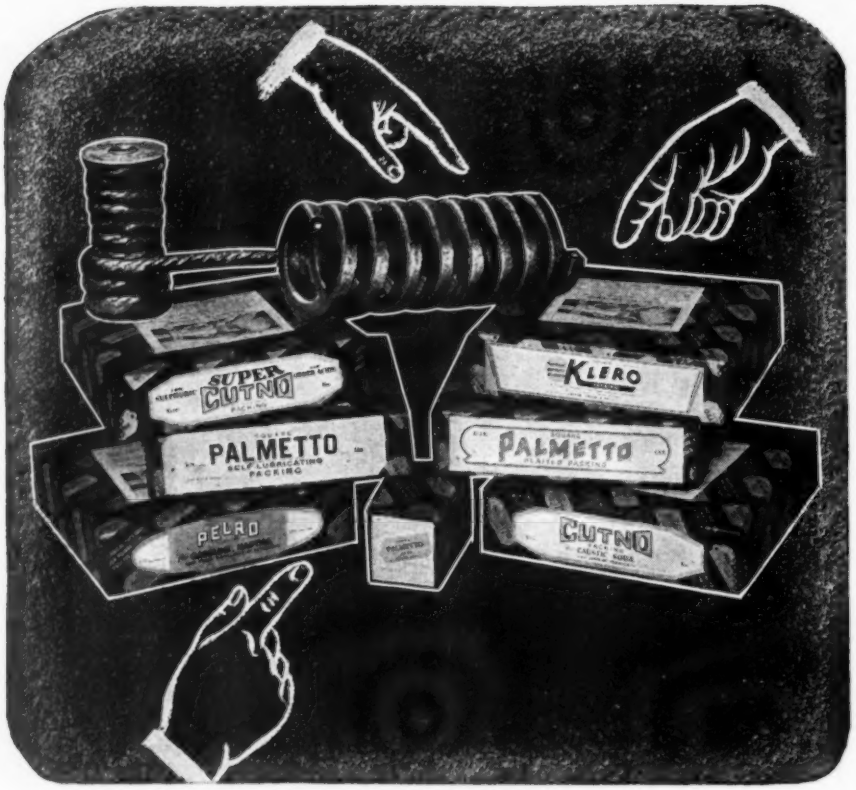
Through generations of research, Johns-Manville has developed a line of insulations that spans the entire range of industrial temperatures and fits every service requirement.

* * *

If you have an insulation problem, why not call on J-M for the solution? Write Johns-Manville, 22 East 40th St., New York 16, N. Y.

JOHNS MANVILLE JM PRODUCTS

JOHNS-MANVILLE *First in* **INSULATIONS**



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You can always put your finger on the RIGHT choice for every service when you standardize on PALMETTO Packings.

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No complexities, no uncertainty . . . for each grade gives good results in a broad range of applications.

Our handy Packing Application Chart will help you make a selection for trial . . . write for your FREE copy.

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High-Pressure Folded Asbestos Gaskets
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PALMETTO for steam, water, air. PELRO for oils. CUTNO for alkalis. SUPERCUTNO (blue asbestos) for acids. KLERO for foods.
Self-Lubricating **PACKINGS**

Centrifugal Pumps Q & A

(*Continued from page* 120)

speed changes directly as its diameter the pump capacity varies directly as the impeller's diameter, while the head varies as the diameter squared and the power input varies as the diameter cubed. For example, in Fig. 3, with a 14.75-in. impeller operating at 1800 rpm the pump has a capacity of 2250 gpm against a 218-ft head, point *A*, and requires 151 hp to drive it, point *B*. If the impeller's diameter is reduced to 14 in., its capacity at 196-ft head will be 2135 gpm, point *C*, and will require 129 hp, point *D*,

A reduction in diameter is the equivalent of a basic-design change of the impeller and thus affects the pump's characteristics. For that reason the basic rule can be applied only over a limited range depending on impeller's design.

When a pump is to be adapted for smaller capacity or head, or both, at the same speed or for the same capacity and head at a higher speed, consult the manufacturer to see whether the existing impeller can be cut down to produce the desired results.

Q 16—Knowing an impeller's diameter and its operating speed how can one determine approximately the head that a pump can develop?

A—The head in feet developed by an impeller at the capacity at which maximum efficiency is obtained can be determined from the formula:

$$H = \left(\frac{D \times n}{1840 \times K_u}\right)^2$$

where H equals head in feet of liquid, D equals impeller diameter in inches, n equals speed in revolutions per minute and K_u equals pump-design coefficient. The value of K_u may vary between 0.95 and 1.15 for normal impeller designs. Generally, using 1.03 is accurate enough, in which case

$$H = \left(\frac{D \times n}{1900}\right)^2$$

Q 17—How does the nature of a liquid affect pump selection?

A—It determines to a certain extent the range of capacities and heads as well as pump types most frequently used for a given service. The widest range of selections is available for water, which is divided into fresh and salt water. Selection of materials for the latter varies greatly from the viewpoint of first cost, length of life and customer's preference and experience. Apparently insignificant impurities in the liquid may be important in selecting the materials.

(*Continued on page* 144)

Always Try Chapman Standard Lines

FIRST

No matter what your valve problem may be, it pays to look through the Chapman Standard Line *first.* Many valves that appear to be "specials" will be found in our regular production.

As new valves have been designed through the years, many of them have been added to our Standard Line. Included are many unusual types and sizes — in steel, iron and bronze alloys.

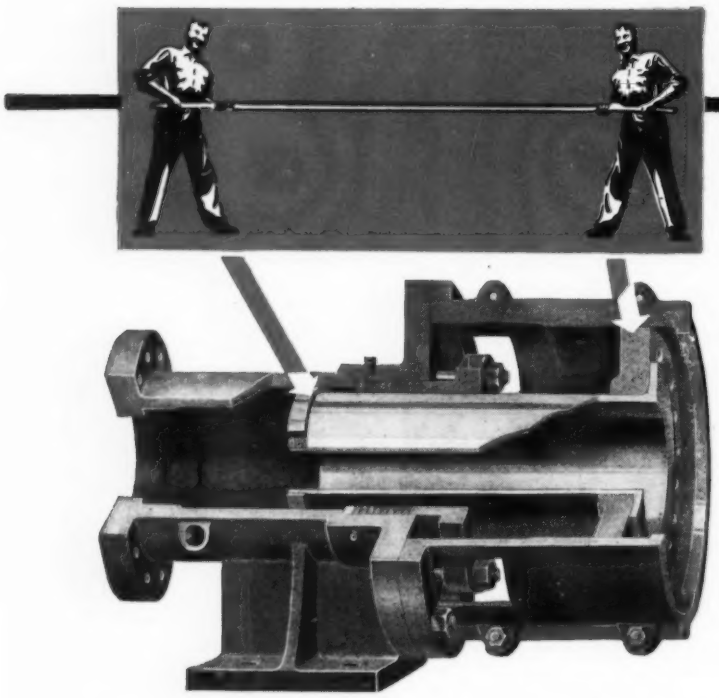
Should a special type of valve be required, Chapman engineers will be glad to help you develop it.

THE
CHAPMAN
VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASS.

ADSCO

INTERNALLY-EXTERNALLY GUIDED EXPANSION JOINTS

Keep the slip in perfect alignment because they are guided at BOTH ends



Slip Moves Through Packing Without Binding

Try to hold a pole at one end and keep it level. Then have someone hold the other end, and note the difference. That's precisely why the ADSCO Internally-Externally Guided Expansion Joint stays in alignment—why the slip moves through the packing space without undue pressure or distortion.

This protection against slip scoring is the reason why the intervals between repacking are few and far between when you use ADSCO Internally-Externally Guided Expansion Joints.

Install them on high or low pressure pipe lines, hot water, fuel oil, gasoline or process—wherever the most complete form of guiding is required. Write for Bulletin No. 35-20P.R. describing ADSCO Internally-Externally Guided Expansion Joints in sizes from ¼" up with 4" or longer traverses.

WRITE FOR YOUR COPY OF CATALOG DESCRIBING COMPLETE LINE OF ADSCO PRODUCTS

AMERICAN DISTRICT STEAM COMPANY

NORTH TONAWANDA, NEW YORK

Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

Similarly, nature of a liquid will affect not only the pump material, but possibly the mechanical construction best suited to the purpose, depending on whether the liquid is an acid, alkali or oil. For example, if acid is handled, not only must the pump be built of corrosion-resisting material, but it must avoid leakage of the acid to atmosphere through the stuffing box.

Q 18—How does a liquid's temperature affect pump selection?

A—A standard line of general-service pumps has definite temperature limitations. Higher temperatures may require special materials, watercooled stuffing boxes or special mechanical features such as centerline support of the casing. Likewise, for extremely low temperatures such as in brine service, nickel cast iron or nickel cast steel may be used in preference to standard gray cast iron to obtain a more refined crystalline structure and prevent fractures. Any wide variations in operating temperatures should also be known as they affect the liquid's specific gravity and viscosity.

Q 19—How does a liquid's specific gravity affect pump selection?

A—Specific gravity must be known to determine the proper size of driver at design conditions. If head is given in pounds per square inch the specific gravity of the liquid must be known to convert the head into feet of liquid handled. If a customer specifies a net pressure of 100 psi for a fire pump, the total head required is 231 ft for fresh water, or 225 ft for salt or sea water with a specific gravity of 1.03.

Q 20—How do the nature and size of solids in a liquid affect pump selection?

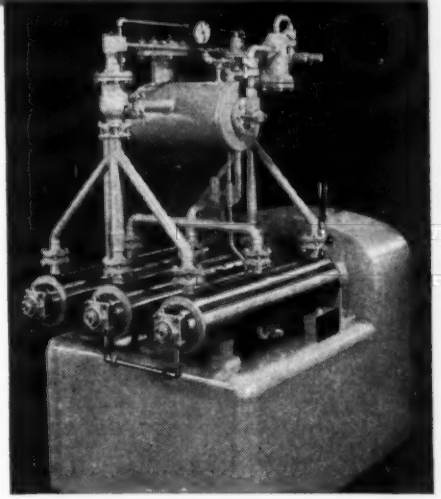
A—They determine the type of impeller best suited for the purpose and the pump's construction materials. If the solids are very abrasive, an open impeller is generally used and, where the pumping job warrants, special and more expensive wear-resisting materials may be justified. If the solids are relatively soft, as is generally true of sewage, a closed impeller can be used. When solids reach a certain size, special nonclogging impellers are required.

Q 21—How does load factor affect pump selection?

A—If a pump is used in intermittent service then it is not necessary to use the most efficient unit available and the selection generally can be made on the basis of lowest first cost. On the other hand, a pump intended for continuous service should have high efficiency, reliability and long life.

Q 22—Does variation in operating conditions affect the selection of pump type?

WHEN PIPING IS PART OF A PRODUCT



EQUIPMENT manufacturers who build products using piping find many advantages in Tube-Turn welding fittings. Here, for instance, is a Votator—one of many models of food processing equipment made by The Girdler Corporation. The piping system must be compact, leakproof, able to withstand pressure at high temperatures. Tube-Turn welding fittings meet every requirement.

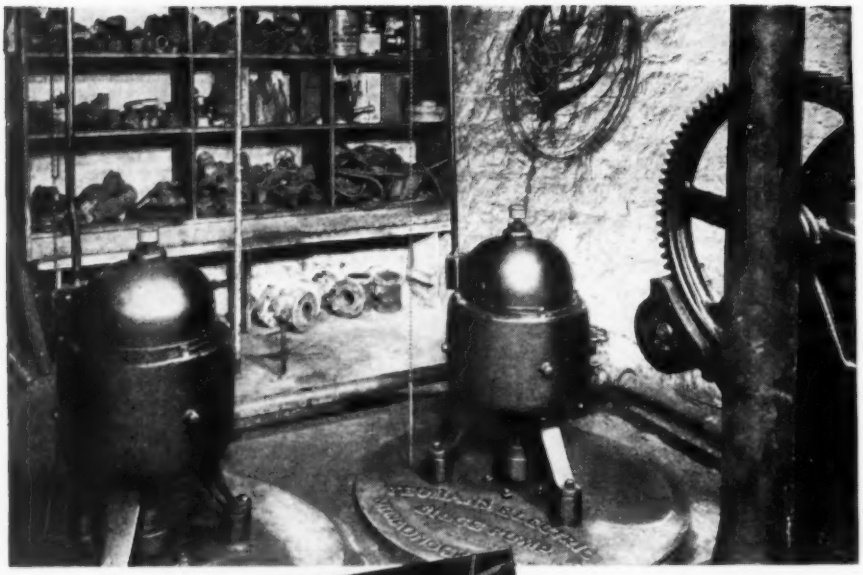
If your product calls for piping insulation, remember that Tube-Turn welding fittings are streamlined, saving insulating time and expense. Their smooth interiors make for maximum efficiency of flow. Their uniform wall thickness permits cutting for odd angles with complete assurance of perfect roundness.

Many equipment manufacturers are discovering what piping engineers have long known—that Tube-Turn welding fittings offer exclusive advantages wherever piping efficiency is a factor. Tube Turns engineers will be glad to help on your individual problem, without obligation.

Selected Tube Turns distributors in every principal city are ready to serve you from their complete stocks.

TUBE TURNS (Inc.), Louisville 1, Kentucky. Branch Offices: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle, Los Angeles.

TUBE-TURN TRADE MARK **tt** *Welding Fittings and Flanges*



THESE VETERANS ARE HARD WORKING PROOFS of YEOMANS QUALITY

● In 1902 in the building of Wilson Brothers Company, Chicago, two Yeomans centrifugal wet pit ejectors were installed to discharge drainage seepage and wastes. No repairs were needed until 42 years later, when rust ate through the suspension pipe of one pump and attacked the impeller. Repairs were made. The other pump is still operating efficiently.

● In 1903 a Yeomans Duplex Sewage Ejector was installed in the La Salle Street Station, Chicago, when it was built. With minor repairs it has operated ever since with quiet capability.

The following bulletins contain important and helpful data . . . write for them.

No. 8003— Centrifugal Wet Pit Sewage Ejectors.

No. 2401— Dry Pit Sewage Ejectors.

● Yeomans Pumps, with their good engineering and sound construction, perform with that dependability which is quickly taken for granted.

COUPON

YEOMANS BROTHERS CO.
1446 N. Dayton Street Chicago 22, Ill.
Please send Bulletins 8003 and 2401.

Name_____
Address_____
State_____

Yeomans Pumps

A—The types of systems on which constant-speed centrifugal pumps are generally applied can be classified as: (1) constant capacity and head (2) variable capacity with nearly constant pressure and (3) variable head with some capacity variation permitted.

Type 1 operation is only at one point on the pump-head capacity curve so that its shape is not important. Type 2 is common when a pump discharges into a system, like the water-supply main of a community or industrial plant, in which nearly constant pressure is maintained irrespective of demand. Here a flat head-capacity curve is desirable. Type 3 occurs when there is a variation in static head such as when filling a tank from the bottom. In some installations considerable capacity variation can be tolerated because of static head changes but in others the capacity variation must be as small as possible. The latter requires pumps with steep head-capacity curves and sometimes for the desired results it is advantageous to sacrifice efficiency.

There are many other cases where variations in operating conditions are such that pumps of special characteristics are required. In some of them the desired results are obtained only by variable speed or throttling.

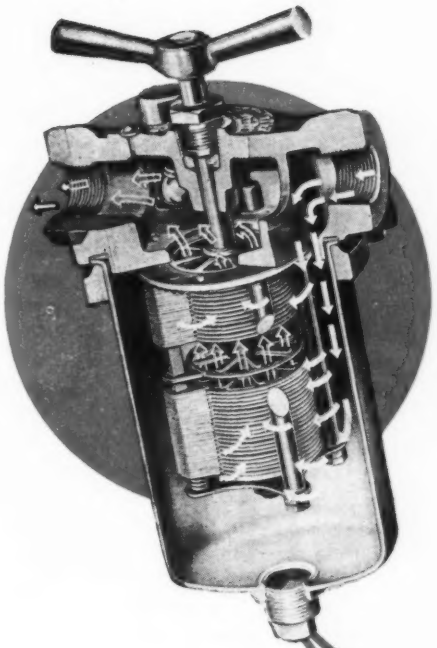
Waterwheel Generator

(*Continued from page* 80)

test showed that all coils but one had a 30-v drop and the bad one showed around 20. Incidentally, this coil opened up in several places, showing shorted turns when removed from the pole and tested in a growler. The bad coil was directly opposite the shaft's rubbed spot.

The plumb-line test showed an apparent kink of about 10 mils in the shaft. with the maximum kink at the rubbed spot, which was on the inside of the bend.

Luckily the customer had a trailer available so the complete rotor could be brought to the factory where we had a lathe large enough to swing it. A lathe check revealed the shaft had kinked 11 mils at the rubbed spot. The coupling flange ran out 8 mils and the coupling face 3 mils. We turned the rotor until the bend was on top and placed a doughnut-shaped ring of wet-ground asbestos, about 6-in. inside diameter, on the shaft directly opposite the rubbed spot. We played an acetylene-torch flame on the shaft inside the asbestos ring until a dial indicator under the shaft showed a lift of 25 mils. When the shaft cooled to room temperature, a rotating check showed a



NO DUPLEX INSTALLATION NEEDED

Cuno Filter Cleans Full Flow Continuously

One reason why Diesel builders like Hill Diesel Engine Company (division of Rogers Diesel and Aircraft Corporation) use Cuno Filters for keeping fuel and lube oil clean is the saving in space and cost compared to duplex installations of alternately operating filters.

The Cuno filter requires no more space than the ordinary partial-flow type . . . yet it handles full flow. And because it is cleanable without stopping flow, a duplex installation is unnecessary.

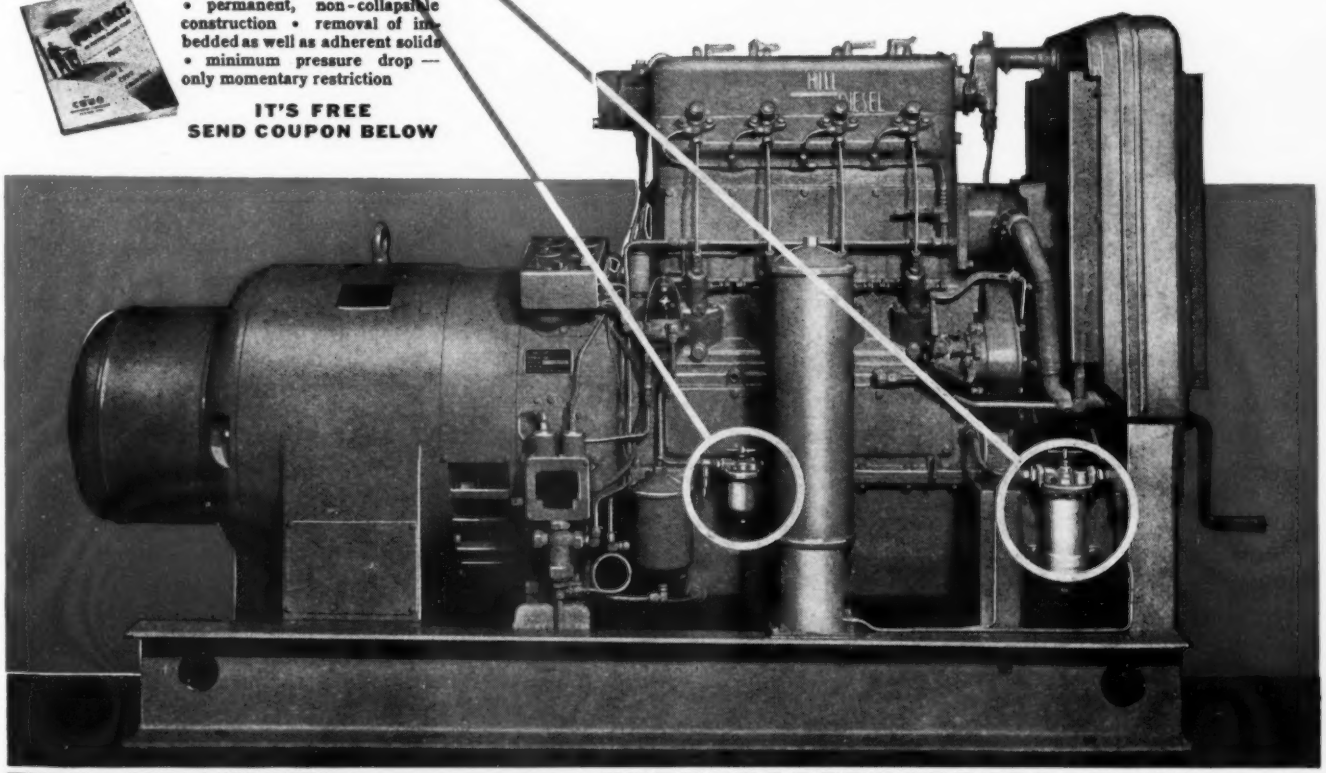
Accurately-spaced, all-metal discs remove from the fluid all solids larger than the openings between the discs. When the discs are rotated past cleaner blades, the accumulations are combed out and drop into the sump. This is done without interrupting the fluid flow.

Thus the only attention required is occasionally turning the handle which controls the stack of discs . . . and emptying the sump.

"QUICK FACTS" IS A FREE BOOKLET DISCUSSING:

positive mechanical edge filtration • permanent, non-collapsible construction • removal of imbedded as well as adherent solids • minimum pressure drop — only momentary restriction

IT'S FREE
SEND COUPON BELOW



KEEP FLOW ON "GO" WITH

CUNO

THE "FILTER-FINE" STRAINER

CUNO ENGINEERING CORPORATION
225 South Vine Street
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Please send me free copy of "QUICK FACTS".

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There's a

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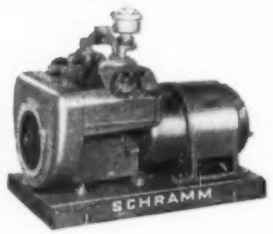
AIR COMPRESSOR

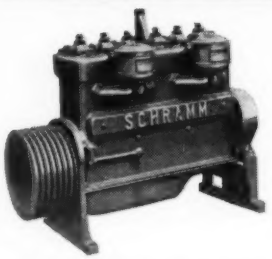
. . . for your every need!

SIZES RANGING FROM 2 TO 600 CU. FT. DISPLACEMENT



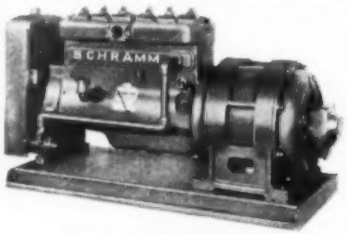
DIRECT DRIVE ON BASE

Built-in Motor Drive mounted on steel base is compact and easy to install. No foundations necessary.



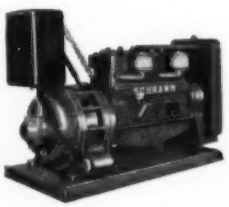
WITH "V" GROOVE PULLEY

Schramm Belt Driven Compressors can be obtained with "V" or flat belt drive suitable for twenty-four hour service and economical operation.



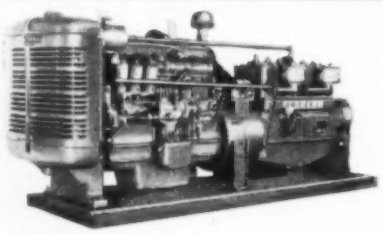
DIRECT MOTOR DRIVE WITH COOLING UNIT

Schramm 300 cu. ft. displacement with direct-connected 50 H.P. motor with cooling unit on Steel Deck Base.



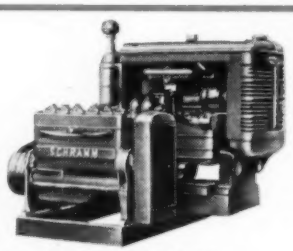
DIRECT DRIVE WITH STARTER AND RADIATOR

Both compressor and motor are mounted as a single unit on a substantial steel base with starter, radiator, and cooling unit.



DIESEL ENGINE DRIVE-IN LINE

Complete self-aligned, direct connected Diesel Engine Driven Compressor for semi-portable or stationary installation.



BELT DRIVE ON BASE WITH ENGINE

Schramm Engine Belt Drive on Base combinations are available for applications not reached by electric power service in mill, mine, and other industrial plants.

SCHRAMM INC. COMPRESSOR SPECIALISTS WEST CHESTER PENNSYLVANIA

4.5-mil runout. A second heat reduced this to 3.5 mils. In shaft straightening, the first heat gives the maximum effect, the second heat a much smaller one, and then you are all through. You can't fool the molecular structure a third time.

As the bearing clearance ran around 10 to 12 mils, we decided to call it a day on the straightening, faced off the coupling and the bottom and top of the thrust-bearing block. When the rotor was returned to the powerhouse and installed in the stator the whole unit was realigned with the waterwheel and put into service. The customer reported it the best-running unit in the plant.

It seems their maintenance engineer had been fighting oil leaks from the bearings and had made the clearance in the oil-vapor guard smaller than the total bearing clearance. This was all right until the shorted turns in one field upset the balance enough to cause the heavy side of the shaft to ride the journal and throw the shaft against the vapor guard. As it didn't squeal or smoke, there is no telling how long the shaft rubbed before it kinked enough to upset the balance and cause noticeable vibration and thumping.

Antifriction Bearings

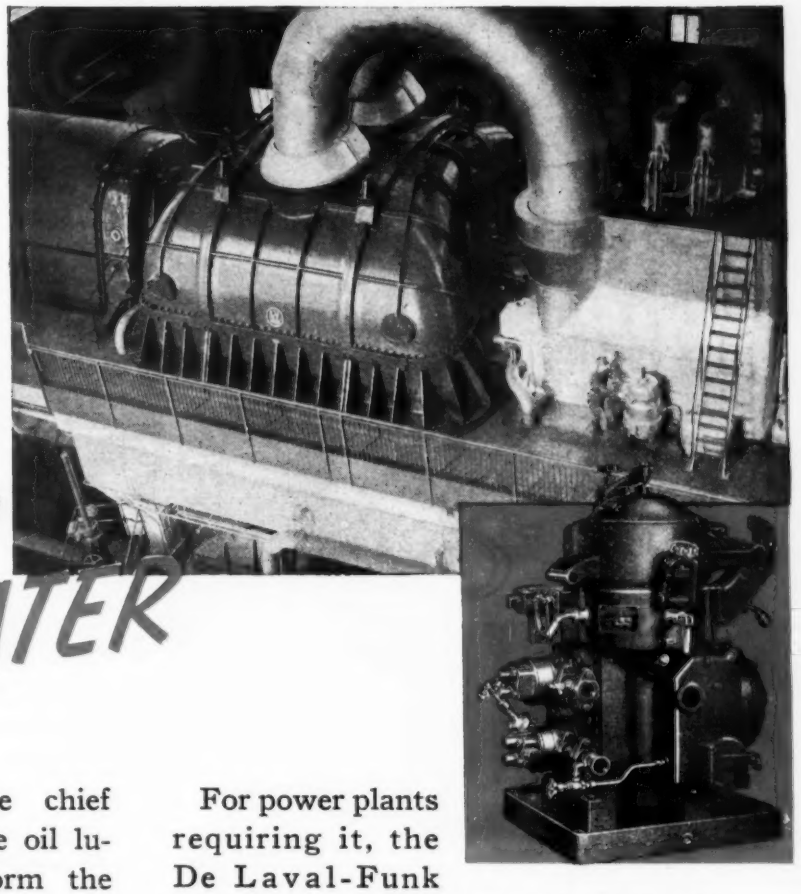
(*Continued from page* 86)

the range of a few ten-thousandths of an inch, and the tolerance on sphericity of balls and on their size is plus or minus 25 millionths. Finishes of important surfaces are measured in micro-inches (millionths of an inch) and all parts are subjected to numerous inspections to keep quality under control. So well is this quality controlled, that bearings, properly selected and mounted, and kept free of foreign matter, give years of trouble-free service with a minimum of attention.

Purpose of an antifriction bearing is to change sliding to rolling friction, which is accomplished by imposing rolling elements between the stationary and rotating parts of the bearing. Most antifriction bearings have four main parts; the outer ring, the inner ring, the rolling elements (balls or rollers) and a retainer or cage. The various parts take a variety of forms but Fig. 1 to 3 show the most widely used designs of the three major types of bearings.

The retainer or cage spaces the rolling elements. Without a retainer rolling elements would not remain equally spaced as they enter and leave the load zone. The bearing would then be out of balance, which would be objectionable, especially

Complete TURBINE PROTECTION *...freedom from* DIRT *and* WATER



WATER is usually the chief trouble-maker in turbine oil lubrication, for water helps form the sludge which ruins oil. Therefore, thorough dehydration of turbine oil is essential. A De Laval Oil Purifier, by centrifugal force, continuously removes condensate or other water at the same time that it removes dirt. Only thoroughly dehydrated oil is returned to the reservoir.

Two-way protection is thus a reality with De Laval centrifugal equipment—double protection which is very inexpensive insurance against trouble. The comparatively modest investment represented by a De Laval Oil Purifier is far outweighed by the cost of even one serious shutdown.

For power plants requiring it, the De Laval-Funk Process is available. This Process minimizes the formation of sludge ***within*** the turbine lubricating system while it also continuously purifies the oil by means of a De Laval Oil Purifier. It is the ultimate in turbine oil maintenance systems—checking trouble at its source.

De Laval Oil Purifiers are furnished in a wide range of capacities to enable every operator to secure the correct unit for his purpose.

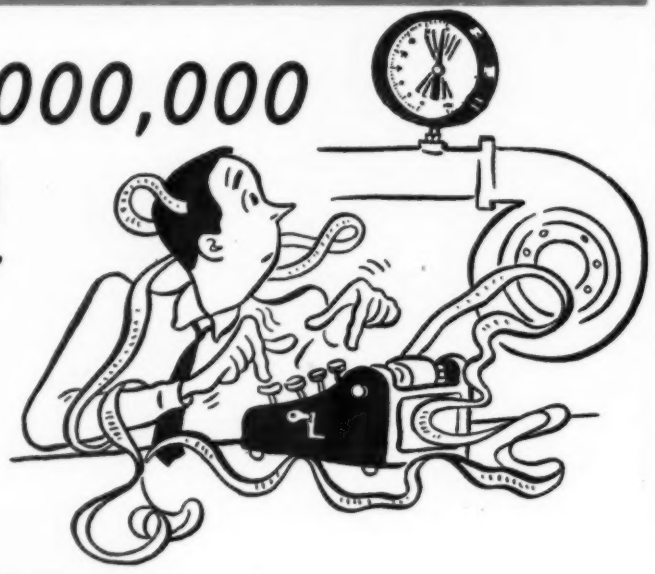
● Write for your copy of Bulletin No. 400.

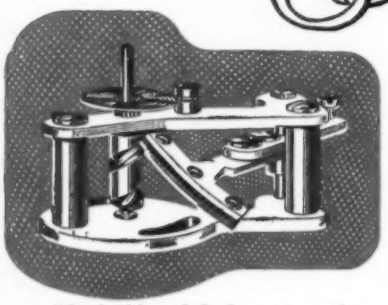
THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 19
THE DE LAVAL COMPANY, Limited
MONTREAL PETERBOROUGH WINNIPEG VANCOUVER

DE LAVAL *OIL PURIFIERS*

FOR MORE DEPENDABLE POWER PRODUCTION

75,000,000 IS A LOT





The highly polished contact surfaces of the graphited Bakelite cam and the bronze helicoid roller account for the unusual wearing qualities of the Helicoid movement.

75 million is a lot of anything. And when any pressure gage withstands 75 million cycles of operation, that represents a lot of gage service.

To determine how much longer Helicoid Gages with Helicoid movements would wear than ordinary gages with spur geared movements, an endurance test was run by an independent testing laboratory.* Two of the best spur-geared movement gages were tested against Helicoid Gages.

All gages were pulsated at the rate of 1200 cycles per minute. One gage failed after 500,000 cycles because the stainless steel teeth were worn away. The other gage failed after 10,000,000 cycles. After 75,000,000 cycles (as of Sept. 5, 1945), the two Helicoid Gages were still operating, and were within an accuracy of ½% and 1% respectively.

This proves that the Helicoid movement greatly outwears spur geared movements and that Helicoid Gages remain accurate long after ordinary gages are worn out.

If your service cost on pressure gages is high, it will pay to switch to Helicoid Gages.†

*U. S. Testing Co., Inc., Hoboken, N. J. See report 42592.

†Formerly called "Certified."

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HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

at higher speeds. Also, the retainer reduces the friction that would be present if the balls or rolls were allowed to contact each other. However, some types of bearings, notably needle bearings, operate successfully without a retainer for certain applications.

Names of the parts of ball and roller bearings and the terms used are quite well standardized among the major manufacturers, as shown in Fig. 4 to 6.

To choose the proper bearing, it is necessary to understand what types of loads are involved. The load may be radial, thrust or angular. Fig. 7 to 14 shows how the load is transmitted through the moving parts of the bearing. Although the arrows are shown going in one direction, the load can pass both ways through the bearings. That is, a load on the housing can be transmitted to the shaft, and a load on the shaft to the housing. Bearings seldom operate in actual service under pure thrust or pure radial load; most loads are combinations of the two. Because of their construction, a radial load on tapered-roller bearing produces a thrust reaction, which an opposing bearing has to take. Tapered-roller bearings must always be mounted in pairs except in rare cases.

Central Station Expansion

(*Continued from page* 67)

are engaged as the consulting engineers.

MARYSVILLE—The Detroit Edison Co: Installation of Unit 8 halted in late 1942 has been resumed towards an expected turn-over date in Oct 1946. This General Electric 75,000-kw 815-psig 910-F 1800-rpm turbine-generator is a duplicate of three at Delray No. 3, and of Unit 7 in Marysville. Steam will be extracted from four stages into feedwater heaters and a bent-tube evaporator.

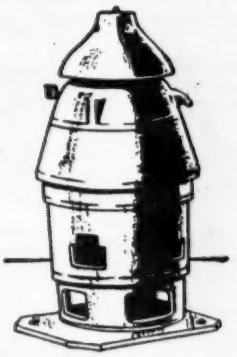
High-pressure boiler capacity will be increased with a fourth Combustion Engineering 440,000-lb-per-hr boiler.

MIDDLETOWN — Metropolitan Edison Co: Designs are being prepared for a new addition. This will consist of two Foster-Wheeler pulverized-coal-fired 250,000-lb-per-hr boilers feeding a General Electric 35,000-kw 850-psig 900-F turbine-generator and a General Electric 3000-kw backpressure turbine-generator. Gilbert Associates, Inc, are consulting engineers.

MOUNTAIN CREEK—Dallas Power & Light Co: Scheduled to go in service in Nov 1945 the extension consists of a General Electric 25,000-kw 70%-power-factor

Q: FROM WHICH COMPANY CAN YOU OBTAIN *any type* OF TURBINE PUMP YOUR JOB REQUIRES?

A: Many important advantages are now offered to users of vertical turbine pumps by Fairbanks, Morse & Co. For this organization not only supplies the regular line of Fairbanks-Morse Turbine Pumps, but also the Fairbanks-Morse *Pomona* Turbine Pumps. This combination of the Fairbanks-Morse and Pomona engineering organizations places at your service the most highly skilled group of engineers in the industry. Moreover, it enables these engineers to supply you with the exact type of pump best suited to *your particular* requirements, regardless of your water-moving job!

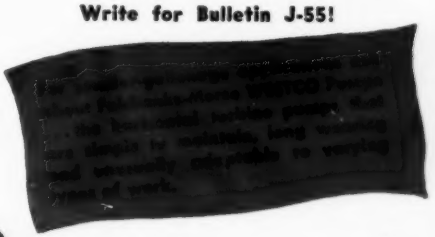


Does your job call for water lubrication . . . or oil lubrication? When you call in a Fairbanks-Morse engineer it makes no difference which you require, for these men are not limited in their choice of pump designs. If your job calls for *oil* lubrication, they will recommend the Fairbanks-Morse Oil Lubricated Turbine Pump. If *water* lubrication, the Pomona Water-Lubricated Pump will be their recommendation. Either way, you get a completely unbiased recommendation on the type of pump best suited to *your* particular application!

Should you have open impellers . . . or closed impellers? Here again—*whatever your need*—Fairbanks-Morse and Pomona engineers are free to recommend the design giving best performance on *your* job. Some applications may call for Pomona's semi-open impellers because of their ability to handle pulpy or grit-laden waters and their ready adaptability to varying flow requirements with proportionate savings in power. In other cases, closed impellers may be more efficient. In either case, Fairbanks-Morse engineers are able to give you the pump YOU need!

GET THE MOST FOR YOUR PUMP DOLLAR by bringing your problem to Fairbanks-Morse. Our trained engineers will gladly make recommendations and work with you on the most efficient and economical solution of your particular water-moving problem. A letter, wire or phone call places this fund of pump "know how" at your service. Fairbanks, Morse & Co., Chicago 5, Ill.

Write for Bulletin J-55!



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ARE THE TWO BRONZE SEATS (GROUND TO A TRUE BALL JOINT)

These two bronze seats, which have been ground to effect a true ball joint, distinguish Dart Unions from all others. Because of this *perfect* seating, a Dart will stay put — leakproof — indefinitely; yet may be uncoupled instantly whenever needed elsewhere. Body and nut are made of high-test air-refind malleable iron — are practically unbreakable. In length of trouble-free service, Darts are the least expensive unions to buy. Ask your supplier.

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Providence, Rhode Island

DART UNIONS

650-psig 825-F turbine-generator. The new Babcock & Wilcox 300,000 lb-per-hr integral-furnace boiler will be cross-connected with two similar existing boilers of 200,000-lb-per-hr capacity.

MYSTIC—Boston Edison Co: First unit placed in operation Nov 1943, second unit was scheduled to start operation Sept 1945, and a third unit with construction just under way is scheduled for March 1947. Each unit will be identical in rating and layout. Single Combustion Engineering 430,000-lb-per-hr boiler feeds a General Electric 40,000-kw 1200-psig 910-F 29-in.-Hg turbine-generator operating at 50,000 kw. Four-point regenerative heating. No dividing wall between boiler and turbine rooms. Jackson & Moreland are consulting engineers.

OHIO RIVER—Southern Indiana Gas and Electric Co: Installation was completed early in 1945 of an Allis-Chalmers 20,000-kw 900-psig 900-F hydrogen-cooled turbine-generator, bringing station capacity up to 72,500 kw. Two years previously a Riley 225,000-lb-per-hr boiler was installed.

C C PERRY, SECTION K—Indianapolis Power & Light Co: A new Babcock & Wilcox 300,000-lb-per-hr 255-psig 600-F boiler and coal handling system are being installed with initial operation scheduled for March 1946. The boiler will supply steam to existing 47,500 kw of condensing units and also for district steam distribution in central Indianapolis. Gibbs & Hill are supervising construction.

PORT WASHINGTON—Wisconsin Electric Power Co: Unit 2 was first operated Oct 1943. A Combustion Engineering 3-drum bent-tube 690,000-lb-per-hr boiler, with Foster-Wheeler combination radiant and convection superheater and radiant-type reheater, supplies an Allis-Chalmers 80,000-kw 1290-psig 850-F reheat turbine-generator.

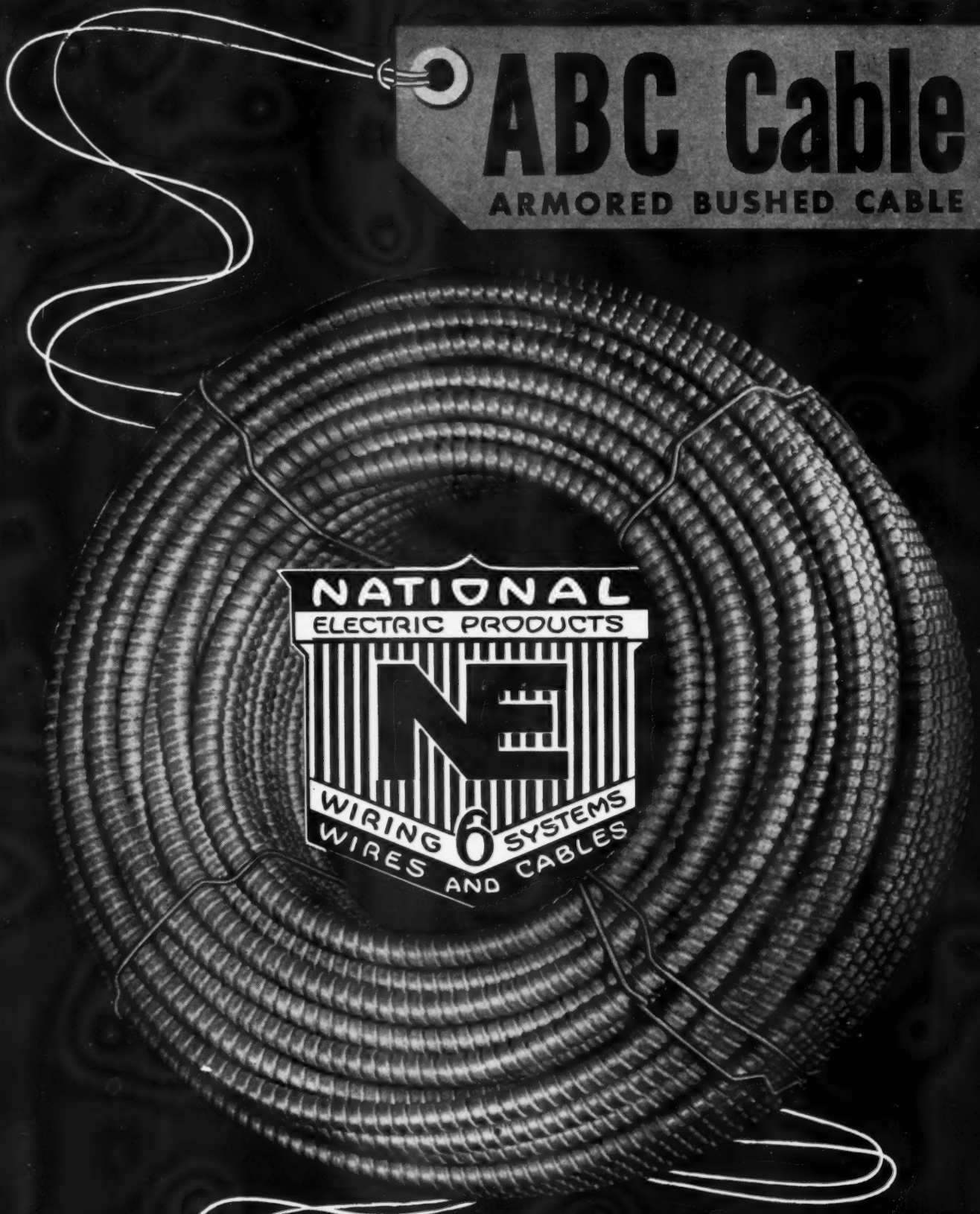
Unit 3 now under construction is scheduled for 1947 initial operation. It is essentially a duplicate of No. 2 except that steam temperature will be 900 F. Attention in turbine design will be given to take advantage of 29.5-in.-Hg vacuum that can be obtained with available cooling water. Design and normal operation is on unit basis. Interconnection of boiler feed lines, service water, compressed air and pulverized fuel of the unit is provided for emergency conditions. Bin and feeder system are used for pulverized coal firing.

PORTSMOUTH — New Hampshire Gas and Electric Co: Placed in operation in Dec 1944 an additional unit consists of a Combustion Engineering stoker-fired boiler rated at 80,000-lb-per-hr feeding a Westinghouse 7500-kw 600-psig 830-F

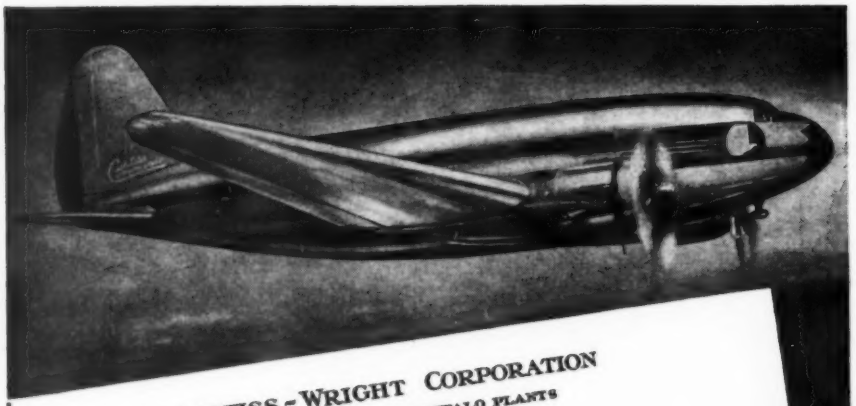
NATIONAL

ABC Cable

ARMORED BUSHED CABLE



National Electric
PRODUCTS CORPORATION
Pittsburgh 22, Pa.



CURTISS-WRIGHT CORPORATION
AIRPLANE DIVISION-BUFFALO PLANTS
BUFFALO, N.Y.

September 12, 1945

Buell Engineering Co., Inc.
70 Pine Street
New York 5, New York

Gentlemen:

It is a pleasure to answer the recent inquiry from your Engineering Department checking upon the mechanical operation of the Buell Dust Recovery Systems installed in our three plants.

Buell Fly Ash Collectors have been in service on twelve (12) boilers since 1941, operating continuously.

Since the time of their installation, they have cost us nothing for maintenance or repair. Their collection efficiency has fully met our requirements, and they have accomplished in a highly satisfactory manner the job for which they were installed.

Yours very truly

Guy Maher

Guy Maher, Plant Engineer
CURTISS-WRIGHT CORPORATION
Plant #2

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DUST RECOVERY SYSTEMS

• BUELL DUST RECOVERY SYSTEMS are used throughout industry in the collection or reclamation of many kinds of dust, in numerous production and process operations. Hundreds of satisfied industrial users will attest to Buell's—"High Efficiency, Low Maintenance, Long Life."

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DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"

condensing turbine-generator. Steam is extracted at two points into one open and one closed heater.

RIVIERA—Florida Power & Light Co: This new plant scheduled to start operating Aug 1946 will be of the semi-outdoor type. Two outdoor-type oil-fired 250,000-lb-per-hr boilers will supply a housed 43,750-kva 850-psig 900-F 3600-rpm turbine-generator.

RIVERSIDE—Consolidated Gas Electric Light and Power Co of Baltimore: Unit 1 was initially operated in Dec 1942 and Unit 2 in April 1944. The units are identical, designed for 2-unit group operation. Each unit consists of a Babcock & Wilcox 550,000-lb-per-hr boiler feeding a General Electric 60,000-kw 850-psig 900-F 1-in.-Hg-abs 3600-rpm, hydrogen-cooled turbine-generator. Turbines exhaust into Worthington 46,500-sq-ft surface condensers.

SARASOTA—Florida Power & Light Co: This new plant scheduled to start operating in Jan 1946 will be of the semi-outdoor type. A 200,000-lb-per-hr oil-fired outdoor-type boiler will feed a housed 18,750-kva 850-psig 900-F 3600-rpm turbine-generator.

SHERMAN CREEK—Consolidated Edison Co of New York: Orders have been placed for a second topping unit which in many of its features will duplicate the topping unit that went into service in 1943. A Combustion Engineering pulverized-coal-fired, 925,000-lb-per-hr boiler will supply a General Electric 50,000-kw 1600-psig 950-F turbine-generator exhausting at 185 psig. All major auxiliaries will be turbine driven.

Removal of several low-pressure boilers and other equipment has begun to make way for the new unit. Initial operation is scheduled for June 1947.

SOUTHWARK — Philadelphia Electric Co: In this new plant two units are to be installed, the first being scheduled for initial operation in Oct 1946 and the second in the fall of 1947. Cross-compound turbine-generators will be rated 150,000 kw, 850-psig, 900-F. An auxiliary unit, rated 12,500-kw, 850-psig, 900-F, will be installed with each main unit together with two open-pass type boilers rated at 850,000-lb-per-hr steam each.

SPRINGDALE—West Penn Power Co: An extension soon to be placed in operation consists of a Babcock & Wilcox 800,000-lb-per-hr pulverized-coal-fired boiler supplying a Westinghouse 65,000-kw 3600-rpm 1250-psig 925-F, condensing turbine-generator. Feedwater heating from four turbine extraction stages in closed heaters, deaerating heater and evaporator. Unit isolated from existing station will increase total capacity to 275,-

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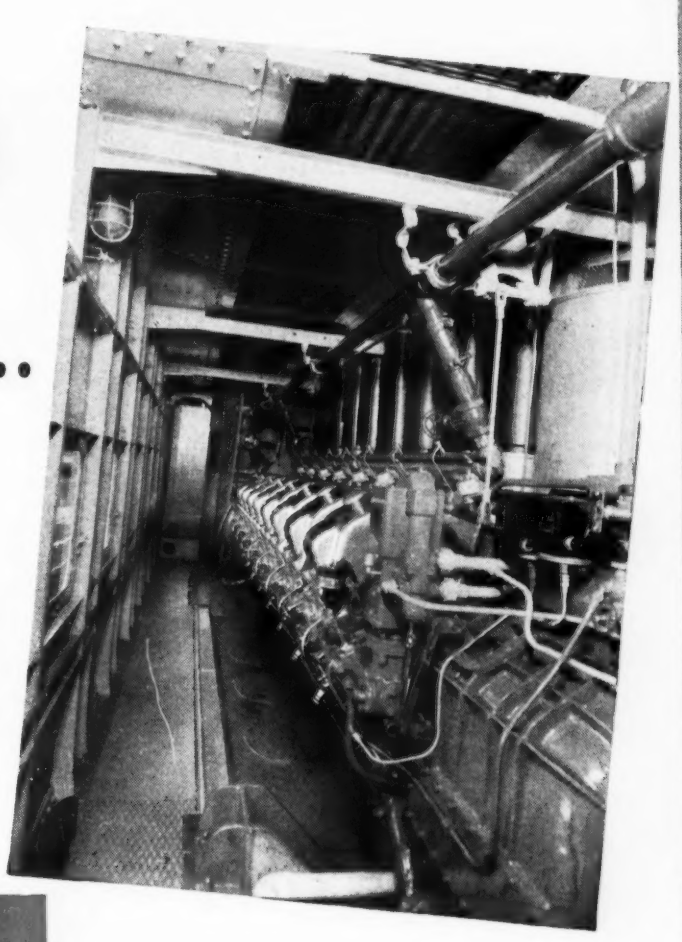
Tough enough for break-ins... gives long, clean service



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DIESEL OIL

ENGINE BUILDERS and many operators use Nonpareil HD Diesel Oil as a break-in oil. They find it provides smoother break-ins with no scratching or scuffing of pistons in cylinders. The detergent quality in Nonpareil HD helps remove the finely divided metal particles resulting from wear in the break-in period. The oxidation inhibitor prevents excessive heat, usually accompanying a break-in, from oxidizing the oil to form varnish and other deposits.

These same excellent qualities provide unusual freedom from wear and deposits in continuous operation under heavy-duty service.

The next time you break in an engine use Nonpareil HD—get off to a good start. Then continue to use Nonpareil HD and see how it lowers cleaning and maintenance costs.

Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Ill.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

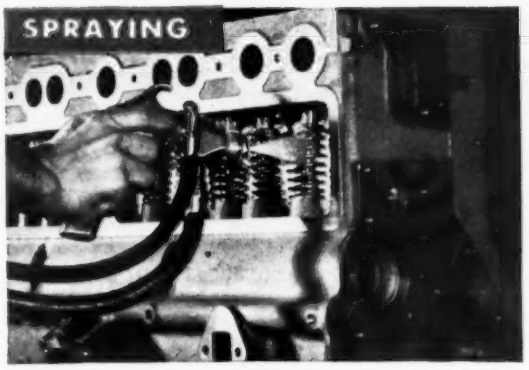
How to get the right rust preventive and the right application

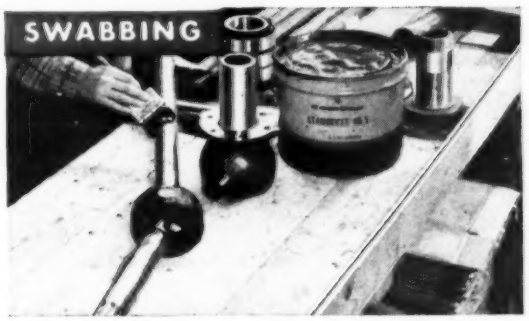
DO YOU WANT help in putting your rust prevention on a more economical basis—one that will assure full protection for parts during production, in storage, or in shipping? Do you want rust prevention that requires the minimum of labor for applying rust-proofing material?

A Standard Oil Lubrication Engineer can give you real help. He has a tested line of rust preventives—Stanorust—plus many of the SR rust preventives approved for use on government equipment. He is familiar with the problems of applying various types of preventives and may be able to suggest shortcuts to save time and labor in your plant.

Put your rust prevention problem up to one of these Engineers. If your plant is in the Middle West, there's one near you. Call the nearest Standard Oil Company (Indiana) office or write, 910 South Michigan Avenue, Chicago 80, Illinois.

STANORUST includes grades for . . .





STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

★ LUBRICATION ENGINEERING

Large illustration shows GARLOCK 150 Spiral. Inset: GARLOCK 200 — Rings, cut to size. Coil form — GARLOCK 125.

QUALITY *Controlled* for long Service

GARLOCK 150 High Pressure Steam Packing is tough, strong, dependable—because it is manufactured from start to finish in the Garlock factory in conformance with Garlock standards of quality. Each ingredient and each operation are *quality controlled* throughout. *Result:* a high pressure packing that gives long, economical service. For superior performance on piston rods of engines, pumps, compressors, expansion joints, etc., against steam pressures up to 300 lbs., specify GARLOCK 150.

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GARLOCK

HOW TO REDUCE STEAM COSTS
INCREASE PRODUCTION EFFICIENCY
IMPROVE QUALITY OF PRODUCTS

If you use steam for industrial processing, the advantages of Stickle Control and Drainage Equipment will interest you. Stickle Equipment affords economy, efficiency and improved quality of products or services in a broad segment of industry such as plants in the food, textile, paper, chemical and laundry fields.

Stickle Feed Water Heater Bulletin No. 117. Fully illustrates types, sizes, construction.

Bulletin No. 235: Complete data on Series 200, Double-seated, Semi-balanced Valves. Bulletin No. 435: Describing Series 400, Single-seated, Balanced Valves.

Bulletin No. 501: Series 500 Stickle Temperature Control Valves, for control of temperatures in industrial processing.

Stickle Steam Traps. Bulletin No. 115: Series 100 for small capacities, medium to high pressures. Bulletin No. 315: Series A E, for larger capacities, medium to high pressures. Bulletin No. 515: Series 50 for large capacities at high pressures. Bulletin No. 415: Series T for low to medium pressures and for vacuum service.

Stickle Differential Drainage and Boiler Return System increases boiler capacity, saves fuel. A closed pumping system. Ask for Bulletin No. 250.

Stickle Triplex Oil and Steam Separators—horizontal and vertical types. Ask for Bulletin No. 200.

PURIFIED AND HEATED FEED WATER

Stickle service starts in the boiler room—with Stickle Open Coil Feed Water heaters. Stickle Open Coil construction permits raw make-up water to be brought into direct contact with steam. This not only gives heaters superior heating capacity, but assures fully one-sixth of boiler feed to be composed of condensed steam, free of impurities. Simplicity of construction reduces attention and makes maintenance negligible.

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Stickle Valves supply a control that makes for maximum operating efficiency. These valves are made especially to handle complicated pressure regulation in fields of service where extremely close limits are essential. In addition to exactness and dependability of construction, each valve is "tailored" to meet specific use and operating conditions. Double-seated, semi-balanced. Single-seated, balanced. Self-contained. Pilot operated.

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Stickle Steam Traps supply rapid removal of condensate—continuously. The Stickle Open Float principle assures a natural positive action—eliminates all troublesome internal mechanism. It is basic to four series of traps designed to meet all drainage requirements. Stickle Differential Drainage and Boiler Return System pumps condensate to boiler, under pressure, at temperature only slightly lower than that at which it leaves traps.

Bulletins listed above supply full information and engineering data on various series of Stickle Specialties. Mailed on request.

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SPECIALIZING FOR MORE THAN 40 YEARS IN REDUCING THE COST OF STEAM

000 kw. Sanderson & Porter are consulting and construction engineers.

STATION NO. 3—Rochester Gas & Electric Corp: Work has started on installation of a Combustion Engineering 400,000-lb-per-hr 660-psig 825-F steam generator. Gilbert Associates are engineering consultants.

SUBURBAN—American Gas & Electric Co: Construction has been started on a unit to be initially operated in early 1947. A 300,000-lb-per-hr boiler will supply a General Electric 25,000-kw 1350-psig 1000-F turbine-generator.

TIDD—American Gas and Electric Co: In Sept 1945 the new unit was initially operated. It consists of two Combustion Engineering 475,000-lb-per-hr boilers feeding a General Electric 100,000-kw 1300-psig 925-F turbine-generator.

WARREN—Pennsylvania Electric Co: Gilbert Associates are preparing designs for a new station at this location. Initial installation will include two Erie City 185,000-lb-per-hr pulverized-coal-fired boilers supplying a Westinghouse 30,000-kw hydrogen-cooled 850-psig 875-F turbine-generator.

WATERSIDE NO. 1—Consolidated Edison Co of New York: Modernization program for this station has been recently approved. This will include replacing three existing 20,000-kw vertical turbine-generators with two 60,000-kw 185-psig 500-F condensing turbine-generators to go in service during the fall of 1947. In the fall of 1948 it is planned to place in operation a 1,000,000-lb-per-hr boiler feeding a 50,000-kw topping turbine designed for 1600-psig and 950-F throttle conditions and exhausting at 200 psig.

WEST JUNCTION—Houston Lighting & Power Co: This new station started operating in June 1943. The boiler is of the outdoor type with the turbine situated on an outdoor deck and having a removable cover. Cooling tower is used for condenser circulating water cooling. Unit consists of a Riley 400,000-lb-per-hr boiler supplying a General Electric 37,500-kw 850-psig 900-F hydrogen-cooled turbine-generator exhausting to a Lummus condensing unit. Only three operators per watch are required. Designed by Ebasco Services.

WHITNEY—Northern States Power Co: Placed in operation in 1940 this station consists of a Vogt stoker-fired 125,000-lb-per-hr boiler feeding a Westinghouse 7500-kw 450-psig 750-F 3600-rpm turbine-generator.

Idaho Power Co has awarded contracts for a new 16,500-kw power plant at a site on Upper Salmon near Hagerman on the Snake River.

LOOKING for TROUBLE!

Designed to stand up in trouble spots, America's newest and widest line of V-Belts — Allis-Chalmers' Texrope — solves every one of these drive problems.

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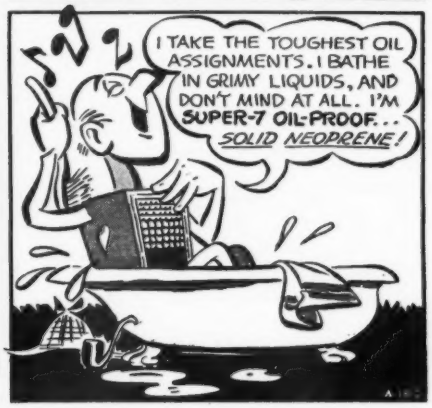

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Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

A 1962

BULLETIN!

SPEED RECONVERSION WITH HELP OF NEW FREE A-C KIT!

Guide to "How to Take Reconversion Inventory" of Drives, Motors, Pumps

Help in the big job of reconverting for peacetime production is now offered to plants everywhere by Allis-Chalmers Mfg. Co., its district offices and distributors. To all who request it, we're sending the new "Reconversion Inventory Kit", planned to speed the task of determining the condition of your existing equipment — V-belt drives, motors, and centrifugal pumps — which will be used in reconverted production.

SUGGESTS PROCEDURE, STATES STANDARDS

Used by foremen, maintenance men, and engineers, the Kit is a real time-saver . . . leads efficiently to probable trouble spots, helps clear them up. Gives bearing tolerances, resistance formulae, etc., in compact, easily-used form. Check List appraisal charts help determine present and future condition of units inventoried.

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ALLIS-CHALMERS MFG. CO.
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Please send Reconversion Inventory Kit free of charge to:

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Address.....

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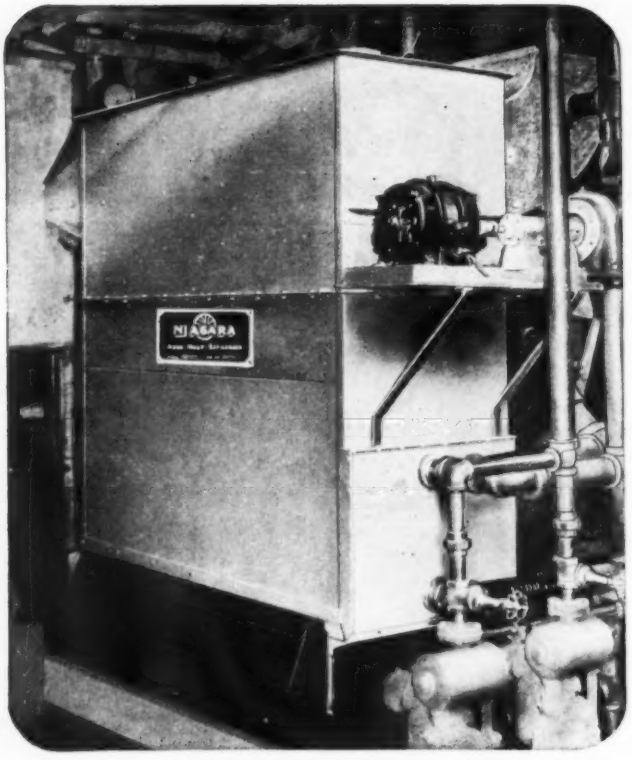
Attn. of Mr.....

HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co.*



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The NIAGARA AERO HEAT EXCHANGER provides a closed system of re-circulated, clean jacket water at a controlled temperature. Operating your diesel or gas engines or other machinery at the correct temperature assures you of full-rated power, and freedom from frequent shut-down and mechanical trouble.

Using the NIAGARA AERO HEAT EXCHANGER also provides operating economies that quickly pay for the equipment. The heat is removed by air and the high cost of cooling water is eliminated.

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INDUSTRIAL COOLING HEATING • DRYING

NIAGARA

HUMIDIFYING • AIR ENGINEERING EQUIPMENT

What Steam Pressure?

(*Continued from page 94*)

this and enthalpy at the throttle, 1319. is 212 Btu. All this heat would be turned into power in an ideal turbine. Since one kwhr equals 3413 Btu, 3413 ÷ 212 = 16.1 lb per kwhr of steam—the theoretical steam rate. If this is divided by the over-all turbine efficiency of 0.687, the actual steam rate is 23.4 lb per kwhr.

Because heat is lost in friction of the steam in the nozzles and blading, and the high-speed wheels and the steam surrounding them, and because there are other losses—all inside the turbine shell—only 50% to about 80% of this ideal heat is given to the shaft. That is, the *internal efficiency* is from 50 to about 80%. This ratio is described sometimes as *engine efficiency* without mechanical or electrical losses.

This efficiency is very low for a single-stage turbine because steam velocity due to the large drop in pressure in one stage is very high, creating large nozzle and blade friction—also because steam leaves the blades at a high velocity. With more stages steam velocity is lower, and losses are lower; hence internal efficiency is higher. Small turbines could be built for high efficiency but manufacturing cost would be so high that no one would buy them. Internal efficiency of a commercial 500-kw turbine is about 60%, and over 80% for a 7500-kw unit. For turbines driving the fans and pumps it may be lower than 50%.

Figuring Exhaust Condition

If internal efficiency is 72.3%, 27.7% of the ideal available heat remains in the steam. Subtracting from the enthalpy at the throttle, 212 × 0.723 = 153, 1166 Btu is the actual enthalpy of the exhaust steam. From either the Mollier diagram or the steam tables, the enthalpy for saturated steam at 34.7 psia is 1167, or 1 Btu higher. Hence there will be $\frac{1}{10}$% moisture in the exhaust.

There is a further heat loss in bearings and generator, about 5% at full load for a 1500-kw unit—less for larger units and more for smaller ones. At half load these losses may be 10% altogether. Not knowing the internal efficiency, we may still estimate the heat used internally from the turbine steam rate. When manufacturers' rates are not available, estimate them from *Theoretical Steam Rates*, published by ASME, or from the "Steam Rate Chart" (POWER, Dec, 1945, p 107) and correction factors (Fig. 19, p 108 Dec). Rates at part load increase in an amount varying with steam

EXTREMELY ACCURATE REGULATION

. . . Extremely Compact in Size!

A fraction turn of the handwheel—and you can control *exactly* the pressure of steam passing through this very compact K & M Reducing Valve. Model 481 is widely used for difficult reduction service in industrial processes—and as a primary valve in double reduction installations. Self-contained . . . made in bronze . . . available in valve sizes of ½" to 2"—with 5⅜" the maximum overall measurement, face to face! Yet it accurately controls inlet pressures up to 250 lbs. . . . maintaining constant reduced pressures of 2 lbs. to 80% of the inlet. If you have a tough pressure reduction problem, perhaps K & M #481 is the answer. Our Engineering Department invites your inquiries.

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MANUFACTURERS OF PRESSURE AND LEVEL CONTROLS
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Even an unskilled laborer does a good job—*speedily*—with B-H No. 1 Cement. This unique product sticks *instantly*—on any surface; no sliding off or rolling up behind the trowel; no droppings when applied to under-surfaces. You get a neat, workmanlike job every time—without trouble and without waste.

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- ☐ Mono-Block—the one-block insulation for all temperatures up to 1700° F.
- ☐ Black Rockwool Blankets (felted between various types of metal fabrics)

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pressures and temperatures, and turbine size. In the absence of more accurate data assume an increase of 13% for half load and 45% for quarter load.

If full-load steam rate is 23.4 lb per kwhr, 3413 ÷ 23.4 = 145 Btu per kwhr. But 5% is lost in bearing and generator; hence 145 ÷ 0.95 = 153 Btu to be taken out of the steam. Subtracting this from 1319 we have 1166, which is the result obtained from the Mollier diagram.

For half load the computation is as follows:

$23.4 \times 1.13 = 26.4$ lb per kwhr

$\frac{3413}{26.4} \times \frac{1}{0.90} = 143$ Btu used in turbine

$1319 - 143 = 1176$ Btu, enthalpy in exhaust

This point on the diagram shows 18-deg superheat. Since the enthalpy for 34.7 psia, saturated, is 1167, the difference of 9 Btu has gone into superheat, giving 18 deg. If there must be no superheat in the exhaust at half load, install a desuperheater or reduce the throttle superheat by about 18 deg. This gives about 1% moisture in the exhaust at full load, but no superheat at half load.

A line connecting throttle and exhaust points shows the steam condition at any pressure during expansion. To bleed at 50 psi (64.7 psia) we find by the intersection of the pressure line with the condition lines that there is 40 deg. superheat at full load and 56 at half load.

Steam rate of a bleeder, or extraction, turbine is about 3% higher than of one designed for no extraction. For more accurate temperature estimates at extraction points draw a new condition line for the higher steam rate.

We have had to omit a large number of refinements in this explanation. Some are covered in the turbine section of Dec 1945 POWER. Turbine efficiencies vary with size, load, throttle pressure and temperature, and exhaust pressure, all of which must be included in such calculations as multistage feedwater heating. We are interested in safe exhaust temperatures and these approximations give the temperatures within about 10 deg, which is as much accuracy as is needed.

Comments on Reducing Valve

By these methods the designer will select such a steam pressure and temperature that the steam can generate all electrical power the factory needs. At some electrical loads there will not be enough exhaust steam to meet the factory's requirements and high-pressure steam must be delivered through a reducing valve to supplement the exhaust. Since a reducing valve has to be installed, it is advisable to design so that there will always be a deficiency of exhaust. A reducing valve that is always

Now...

High pressure boiler feed pumps with 0-100% capacity control have constant speed, high efficiency... with distinctive simplicity

Whether the pressure is 500 PSI or 5000 PSI, the Worthington Automatic VARIFLO Triplex Power Pump is your best selection for a high pressure feed pump for boilers and desuperheaters.

The photograph shows the easy accessibility of the stuffing boxes on top of the cylinder (an exclusive Worthington design), making routine attention easy . . . The first Worthington VARIFLO in service taken down after 12 months of continuous service, showed tool marks still evident on the stroke-changing elements. . . . The features listed below mean reduced operating costs, uninterrupted and continuous service.

1. Stepless capacity variation from 0% to 100% thru a simple, compact and proven mechanism.
2. Full accessibility of stuffing boxes, plungers, valves and running parts, simplifying operation and maintenance.
3. Patented flange and screw type stuffing box gland tightens evenly on packing. Gland cannot become cocked when adjustment is made.
4. High efficiency over full range of capacity and pressure.
5. A standard constant-speed motor or turbine may be used for driving with resulting over-all economy in power consumption.
6. Pressure-lubricated drive shaft and stroke-changing elements are a self-contained assembly.
7. Lubrication is fully automatic with splash and pressure system to all bearings.
8. Crankshaft is at the bottom, engine-style — loads are transmitted and supported close to foundation.
9. Running parts are fully enclosed.

Bulletin W-414-B50 on Worthington VARIFLO Power Pumps is "must" reading for all engineers interested in efficient boiler feed service. Write for it today. *Worthington Pump and Machinery Corporation, Harrison, N. J.*

WORTHINGTON

PS-12

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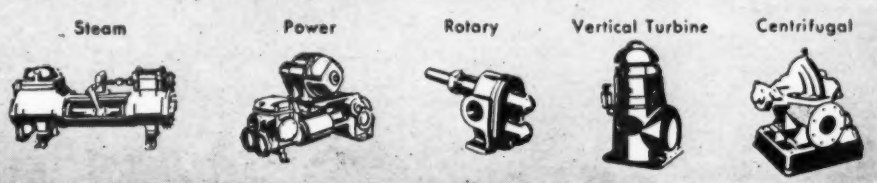

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This universal packing — consisting of long, tough fibrous asbestos fibres, thin flakes of anti-friction metal, minute graphite scales and a heat-proof lubricant — is recommended for general service against steam, water, air, ammonia, oils, gases, etc. where temperatures do not exceed 600°F. Fits all sizes and shapes of stuffing boxes. Special styles available for high temperature and corrosive liquids, for products, etc. Try it and you'll use it regularly.

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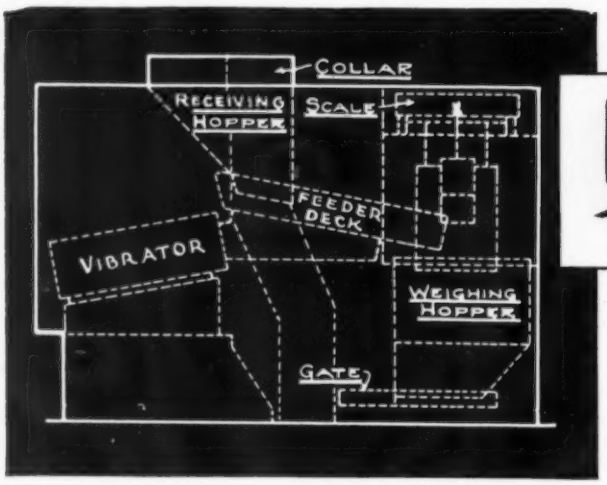
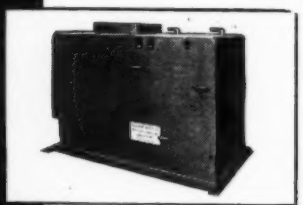
For 6" scale with pipe diameter marking, write Department 99-11

KEWANEE BOILER CORPORATION Kewanee, Illinois

Division of American Radiator & Standard Sanitary Corporation





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- Dustproof cabinet
- Quiet operation
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- Handles wet material

WET COAL can't stick to the Beaumont "Vibro" Automatic Weighing Scale Feeder.

No rotating parts in the Beaumont Scale to which wet coal can stick. Simplified design ensures accurate—automatic—weighing of coal, and similar materials. Feeder capacity adjustable. Units made for feeding materials at from 1 to 60 tons per hour. Request descriptive bulletin.

BEAUMONT BIRCH COMPANY

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DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

in use is less likely to stick than one that may be closed for long periods. After the plant has been operating long enough to obtain reliable operating records, if too much steam is passing through the reducing valve, the throttle pressure can be reduced.

However, there is no fuel loss if steam is delivered through a reducing valve so long as no exhaust steam goes to condenser or atmosphere. An engineer must watch the exhaust head and the combustion efficiency. There is little else he can do except prevent miscellaneous wastes.

Argument Corner

(*Continued from page* 128)

worked. Said Mr. Benston: You want to multiply 67 by 489. You know how to multiply and divide by 2 and no fractions. That's all. So you do this:

Halve this column	*Double this column*
67	489
33	978
16	1956
8	3812
4	7824
2	15648
1	31296

Cross out all right-column figures opposite even numbers in the left column. Then add what's left. Thus:

489
978
31296

32763 = 67 x 489

It is fairly easy to see how this trick works when number in left column is divisible by two. Difficulty comes in seeing how it works when left-column number is not divisible by two. For example, when multiplying 35x13.

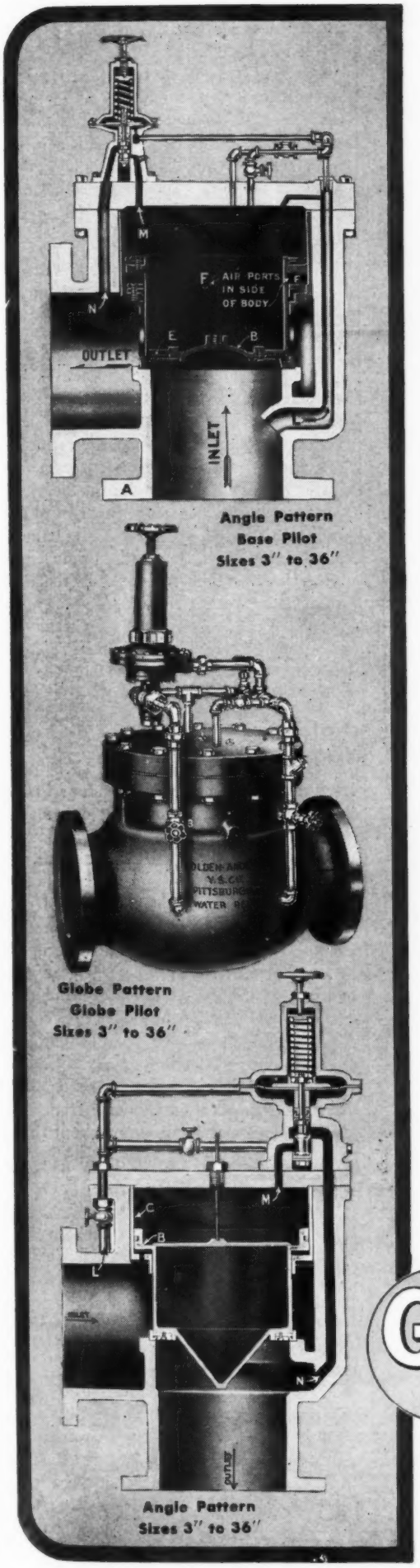
Halve this column (rejecting fractions)	*Double this column*
35	13
17	26
8	52
4	104
2	208
1	416

If we strike out of the right column all those numbers opposite even numbers in the left column, we have remaining:

13
26
416

Total 455 = product of 35 and 13.

In dividing 35 by 2 and putting down



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that provide ***ENGINEERED PROTECTION***

against • **LINE SURGES**

• **EXCESS PUMPING HEAD**

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Automatic

WATER PRESSURE RELIEF VALVES

On excess pressure, due to any line surges or excess pumping head, these valves automatically open to dissipate necessary water volume to maintain the predetermined line pressure. The valves are arranged with either atmospheric pilot valve exhaust or self-contained, according to the service conditions and requirements. They may be arranged to open at abnormal pressures and held open under subnormal pressures until the surge subsides and then close automatically when normal conditions prevail. Consult Golden-Anderson engineers on any difficult flow control problem.

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349	1.02	1.18	2.30	3.68	9.21
549	1.07	1.42	3.84	6.14	15.35
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2349	1.45	3.53	17.65	28.24	70.61
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17, we have really reduced 35 to 34, and divided 34 by 2 = 17.

But 35x13 = (34x13) + (1x13). That is, there is a remainder of 13 to include in the product; and since this is opposite an odd figure in the left column, it is retained and later added.

35x13 = (34x13) + (1x13); remainder 13
34x13 = 17x26
17x26 = (16x26) + (1x26); remainder 26
16x26 = 8x52
8x52 = 4x104
4x104 = 2x208
2x208 = 1x416
So 35x13 = (1x416) + 13 + 26 = 455

That is, so long as the number in the left column is divisible by two, there is no remainder, and the number in the right column is struck out; if the figure in the left column is odd, there is a remainder (value equal to the number in the right column opposite it) and which must be retained. Product is the sum of (1 times the last number in the right column) and the various remainders opposite the odd numbers in the left column.

Buffalo, N. Y. L A CHERRY
Cherry, Cushing and Preble

Refrigerating Effect Improved Several Ways

DATA FURNISHED BY *GAR* (Reader's Problems, Oct 1945) indicate that difficulties other than lack of evaporator capacity may be responsible for the failure to increase refrigeration by working the evaporator at 10 instead of 20 psig. Heat transfer per square foot of evaporator surface varies directly as the difference in temperature between the refrigerating medium in the evaporator coils and the refrigerated medium outside the coils. Ammonia at 20 and 10 psig evaporates at +5 F and −7 F respectively. Therefore, with 15-F air temperature outside the coils, refrigeration increase from 20- to 10-psig evaporating pressure should be:

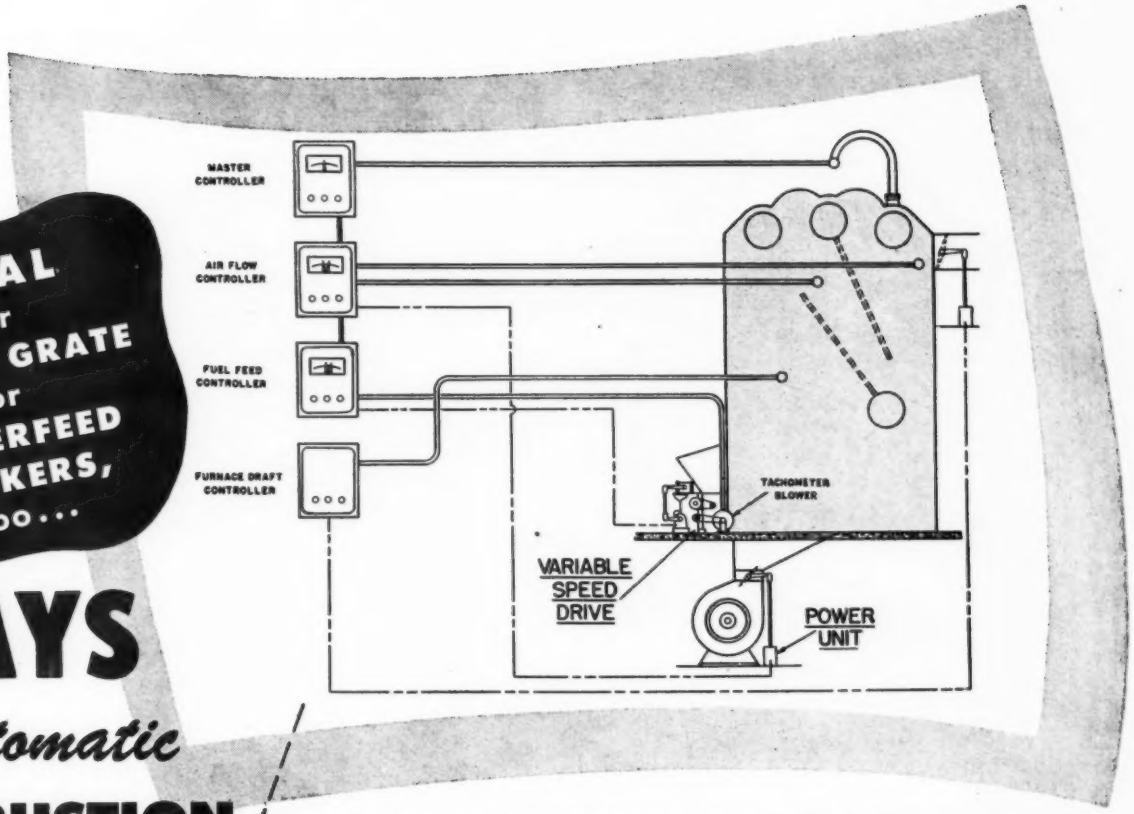
$$\frac{15-(-7)-(15-5)}{15-5}=\frac{22-10}{.10}=\frac{12}{10}=$$

1.2 or 120%

This is a considerable increase in refrigerating effect and should permit more than a slight increase in produce handled through the storage room.

GAR says that formerly with a smaller volume of produce one compressor operating intermittently maintained the desired 15-F storeroom temperature. He also states that the evaporator coils are on one wall, but gives no information regarding dimensions of the storeroom or the method of air circulation. Several things could affect the refrigerating effect of the existing installation, some of which are as follows:

IDEAL for CHAIN GRATE or UNDERFEED STOKERS, too...



HAYS *Automatic* COMBUSTION CONTROL

...HOLDS STEAM PRESSURE CONSTANT... AND EFFICIENCY AT ALL RATINGS IS UNIFORMLY HIGH

Primary unit of the Hays System is the Master Steam Pressure controller. Connected to the main steam header, it controls the operation of other units in the system—makes certain that they supply the correct amount of air and fuel to maintain steam pressure constant and the efficiency of all ratings uniformly high.

- ***Air Flow Controller*** — measures the rate of air flow by taking the draft loss through the boiler; and operates the forced draft inlet damper to maintain the correct rate of air flow for efficient combustion.
- ***Fuel Feed Controller*** — varies the stoker-speed-control device, measured by a tachometer blower, to maintain the correct rate of fuel feed in relation to the rate of air flow.
- ***Furnace Draft Controller*** — operates the boiler outlet damper, to maintain the furnace draft constant at the predetermined value for which it has been adjusted manually.

Result: Steam pressure is maintained constant regardless of fluctuation in steam demand; and a highly efficient rate of combustion is maintained with corresponding saving in fuel.

Applicable to any method of fuel feed, and to the use of any kind of fuel in any size of power plant, Hays Automatic Combustion Control has the outstanding advantage of all-electric operation with all its important economies. Also it may easily be switched, when and if desired, from automatic control to manual operation in full or in part.

For full details and application drawings for 14 different systems, write for Bulletin 46-605.

HAYS

THE MODERN SYSTEM... *it's electrical*

Automatic COMBUSTION CONTROL

THE HAYS CORPORATION • MICHIGAN CITY, INDIANA

Accurate
CONTROL of
WATER LEVEL
for Elevated
TANKS
With
AUTOMATIC TANKTROL CONTROL CO.

For controlling remote and nearby elevated tanks by pressure, TANKTROLS are unsurpassed. Handles up to 3 or 4 pumps or alarm circuits. The TANKTROL exclusive two-bellows construction assures accuracy of 1% and full sensitivity over unusually wide operation range. Settings are permanently accurate. Automatic surge and backspin protection. Bulletin T-11 gives complete information—write for it. State requirements and engineering data will be furnished.

NO
WATERLOGGING
OR AIR-BINDING
In Hydro-Pneumatic
(Pressure) Tanks with
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The DUOTROL maintains high water level at a fixed point and correctly balances air pressure at that point after each pumping operation. It provides a maximum volume of water with a minimum of pump operation, saving power and reducing wear. Easy to install, stable adjustments. Ask for Bulletin D-6.

AUTOMATIC CONTROLS are used by all leading pump manufacturers. When ordering new pumps, specify controls by AUTOMATIC CONTROL CO.

"AUTOMATIC" also makes float operated controls: multi-circuit sequence type, multi-circuit program type, float switches, automatic alternators, and many special controls built to specifications.

AUTOMATIC CONTROL Company
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(1) Evaporator-coil interior surfaces could be fouled with oil, sludge or sediment. Resulting after a long operating period, this would cause a heat-transfer loss.

(2) Excessive accumulation of frost and ice on the exterior of the evaporator coils would also retard the heat transfer.

(3) Deterioration of storeroom insulation or excessive opening of doors would require greater refrigeration to maintain desired temperature.

(4) Improper stowage of the increased volume of produce handled would interfere with air circulation in the storeroom. This would require abnormally low temperatures adjacent to the evaporator coils to maintain desired temperatures at remote parts of room. Assuming that none of the adverse conditions suggested exists, increased refrigeration could be obtained by installing additional evaporator coils. The new coils should be connected in parallel with the existing evaporator and located to get adequate circulation of air over them.

If warm liquid ammonia enters the evaporator it burdens the evaporator coils with gas flashed at the expansion valve, which cools the remaining liquid ammonia to evaporator temperature. This flashing produces the characteristic hissing sound so often noticed at expansion valves. The gas thus flashed has expanded and performed its refrigerating effect in cooling the remaining liquid ammonia and therefore occupies space in the evaporator coils that liquid ammonia might otherwise occupy. This reduces the total cooling effect that could be obtained if the ammonia were cooled before entering the coils. This loss of capacity, however, is seldom serious, and the benefits of a separate liquid ammonia cooler usually do not justify the expense except in large plants.

Seattle, Wash. J H BENDER

Baffle Makes Water Level Fluctuate

DIFFICULTIES ARE OFTEN EXPERIENCED in maintaining accurate and steady water level in the gage glass of some boilers operated under conditions similar to those described by *ABQ* (August 1945 Reader's Problems).

When water rises to the top of the glass and recedes slowly after the water column or glass has been blown down, it is a strong indication that the upper connection is obstructed. However, since the piping has been renewed recently, it is safe to assume that all connections are free and that something else causes the incorrect water level.

ABQ's sketch shows that the outlet to

. . . SEE REVERE AT THE METAL SHOW CLEVELAND, FEBRUARY 4-8

AT the FIRST RECONVERSION SHOW be sure to see the Revere Exhibit. You will find it in Space B-306, the same location in which you found us in the two previous Metal Shows.

Now we are able to point out, openly, definitely and in much more detail than ever before, the amazing advances in metallurgy born of war. In addition we shall re-emphasize the virtues of the more familiar Revere mill products.

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Revere Exhibit at the 1944 Metal Show

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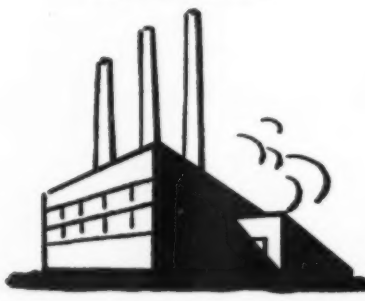
WITH
HENSZEY CONTINUOUS BLOWDOWN

The Henszey system keeps boiler water concentration within safe margins—preventing foaming, priming, carryover and the formation of sludge and scale (with proper chemical treatment). All this is accomplished, continuously, automatically and *WITHOUT* the HEAT LOSS of ordinary blowdown.

The savings due to clean, efficient boilers, in manpower, equipment and fuel are cost of production factors that are now doubly important.

The Henszey system of continuous blowdown is applicable to existing or planned boilers — send now for folder: "Complete Automatic Control of Boiler Concentration."



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BOILER PLANT SPECIALTIES
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CONTINUOUS BLOWDOWN

Boiler Feed Regulators • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves

the upper connection is in the boiler-drum section inclosed by the internal baffle, and also that it is near the steam outlet. There would be a slight decrease in pressure in this area because of flow through the nozzle. Internal baffle also restricts the flow. These two conditions cause a slight pressure differential between the section inclosed by the baffle and the remainder of the drum sufficient to unbalance the water level and cause the high-water condition.

This condition would be more pronounced immediately after the column has been blown down. However, in all probability the water level in the glass is slightly higher than that in the boiler during normal operation. Easiest way to solve the problem is to move the upper water-column connection from inside the internal baffle to the top midpoint of the drum.

Stop valves in the column connections should be of the full-opening type because some globe valves restrict the flow enough to unbalance the water level. When using stop valves it is good practice to lock or seal them open to eliminate any possibility of closing the valve by mistake.

Norwood, Ohio W A RECORD

Superheated Water Is Dangerous

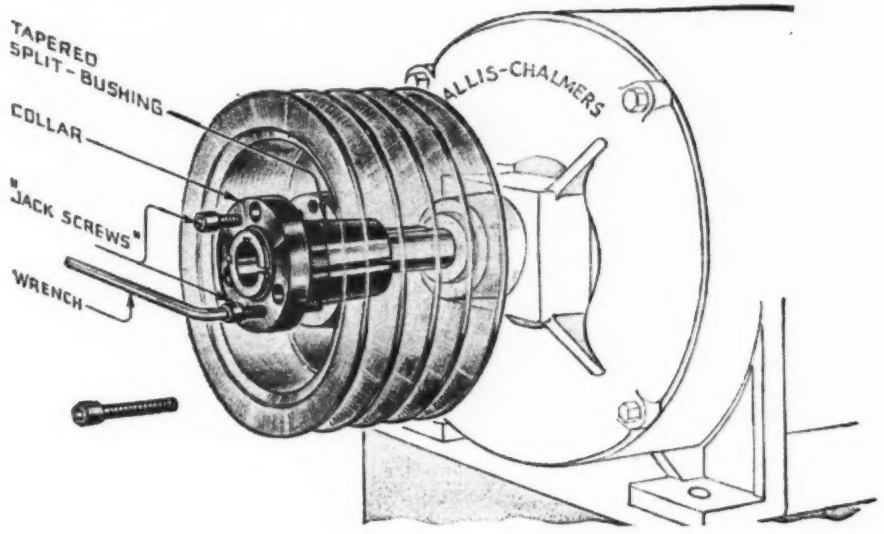
METHOD OF HEATING WATER used by *PAH* (August 1945, Reader's Problems) is undoubtedly highly efficient. However, its continued use is not advisable because of the vibration and disturbances created. The vibrations place excessive stresses on the piping as well as the storage tank and encourage leakage at seams and pipe connections. Continuous flexing and stressing of the shell plate caused by disturbances within the vessel can lead to embrittlement from metal fatigue.

A vessel containing water under pressure which is heated above the flash point of 212 F presents an explosion hazard. A vessel could rupture from over pressure but there would be no resulting explosion unless the water temperature exceeded 212 F at time of rupture. When superheated water is suddenly released to the atmosphere, part flashes into steam causing an increase in volume, which imparts high velocity to the steam formed, resulting in an explosion.

Water under pressure will not boil until a temperature corresponding to the pressure is reached. However, water heated above 212 F. which is to be used at atmospheric pressure, is a waste of heat because part of the water, the amount depending upon its temperature,

It's Easy to See

THE SECRET OF THE "MAGIC-GRIP" SHEAVE



Fastest mounting and demounting sheave on the market, the new "Magic-Grip" costs you nothing extra.

SEE HOW THIS SHEAVE REMOVES EASILY, SAVES TIME AND MONEY

1 **Remove three capscrews** from bushing collar with handy wrench. Insert two capscrews. When turned, they become levers... automatically breaking the tight grip of tapered split bushing on both sheave and shaft.

2 **Remove sheave from shaft.** Requires no mallet, no prying, no bulging muscles. You just slide the sheave off... smoothly, quickly. *It costs nothing extra!* Send for B6310. Allis-Chalmers, Milwaukee 1, Wis.

RECONVERTING?

GET THIS NEW FREE KIT!

To help you find out how your present equipment will fit into future production, A-C offers a new free "Reconversion Inventory Kit" — Fact Sheets and Check Lists to speed your appraisal of V-belt drives, electric motors, and centrifugal pumps. Applies to all makes. Call your A-C distributor or district office, or write Dept. 18, ALLIS-CHALMERS MFG., Milwaukee 1, Wisconsin.

A 1859

Allis-Chalmers Texrope

"MAGIC-GRIP" **SHEAVES**

HEAR THE BOSTON SYMPHONY: *Saturday, American Broadcasting Co.*

JEFFERSON
Specialty UNIONS
with the **RECESSED BRASS SEAT**

To help you eliminate unnecessary pipe joints

The use of Jefferson Specialty Unions insures a minimum of pipe joints and thereby saves time in installing piping systems. Then, too, fewer pipe joints mean lower piping maintenance and less opportunity for leaks.

In addition to these advantages offered by specialty unions, Jefferson brings the exclusive feature of the Recessed Brass Seat . . . a true machined and precision ground joint providing *surface* contact, which can be made up without jamming. This ring is virtually one piece with the iron and is so located that pipe ends cannot come in contact with it should the pipe be screwed in too far.

The 90° Union Elbow shown is representative of the complete line of Jefferson Specialty Unions which include 45° Elbows, and Union Tees in All Male, All Female and Male-Female types, to meet all piping applications.

Ask for further details or get in touch with your nearest distributor.

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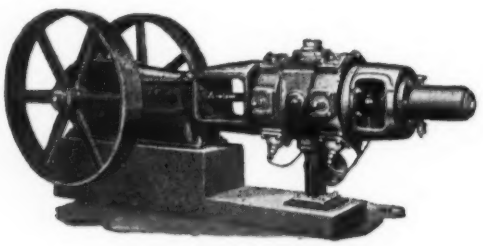


Pennsylvania Oilfreair Compressor

In the selection of an oil-free-air compressor it is important to determine whether the design affords the greatest measure of protection to the carbon piston rings.

PENNSYLVANIA *Oilfreair* design has solved this problem by providing for a *fully floating* piston. This is accomplished by extending the piston rod into an outboard bearing which makes possible crosshead support of the rod at both the main frame and outboard end of the compressor.

Naturally, this design prevents the piston from coming in contact with the cylinder wall, greatly prolongs the life of the carbon rings and positively eliminates all danger of scored cylinders.

Descriptive bulletin 188 on request

PPC

PENNSYLVANIA PUMP & COMPRESSOR CO

BUSHKILL PARK ROAD, EASTON, PENNA

flashes into steam as it is drawn from the storage tank. Excessive water temperature also tends to weaken storage tanks, particularly the standard hot-water tanks used for domestic purposes.

Highest possible pressure that could be attained in the storage tank using 40-psi steam in direct contact with the water is 40 psi. Additional water pressure from any source would cause the water to enter the holes in the steam coil and eventually stop the steam flow.

Water under pressure at a temperature corresponding to 40-psi steam contains a tremendous amount of heat energy. Thus if the storage tank should fail either from over-pressure or from structural weaknesses, a disastrous explosion would result.

Norwood, Ohio W A RECORD

Have Water-Column Lines Short and Direct

THE FOLLOWING CHANGES should be made in the piping so that the true water level will be indicated in the glass (August 1945, Reader's Problems).

1. Install water-column bottom connection as close as possible to bottom of drum or in upper part of header just below the lowest permissible water line, but in a place where the water circulation is not rapid.

2. Make water-column connections as short and direct as possible since the longer the lower pipe the greater the temperature differential between pipe and boiler water.

3. Provide all connections with crosses so that plugs can be removed and pipes checked to be sure the connections are clear.

Water in the long pipe connection is cooler than that in the boiler and when the proper temperature equalization is reached between the boiler water and that in the pipe, the water level becomes stabilized.

The baffle is usually placed in a boiler of this kind to arrest water spouting which occurs when the boiler is run at high rating although its function is to direct circulation flow to rear of boiler.

Altoona, Pa. C M SNYDER

Army Air Forces will sponsor a series of forums, to be held in Pacific theater of war, on employment opportunities for veterans. Representatives of the National Assn of Manufacturers, American Federation of Labor, Congress of Industrial Organization, Veterans' Administration, U. S. Employment Service and U. S. Chamber of Commerce constitute the delegation.

SHAW

KNOWN SINCE 1893 FOR HIGH-QUALITY

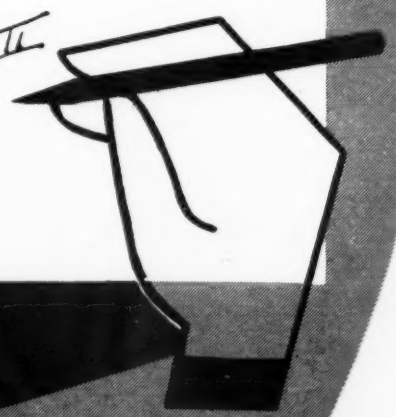
DEPENDABLE PIPING

Pre-Fabrication & Piping Installation

Benjamin F. Shaw Company is qualified to prefabricate and erect piping—any place in the United States and Canada.

Benj. F. Shaw II

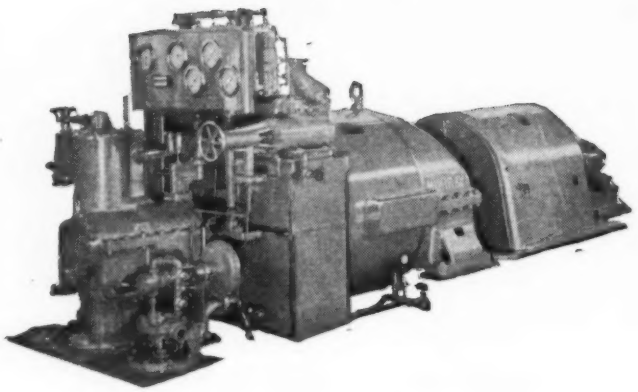
PRESIDENT



BEN[illegible]SHAW COMPANY

2nd and Lombard Streets · Wilmington 99, Delaware

MURRAY
STEAM TURBINE GENERATING UNITS



Installed in 1939 in a small municipal power plant in northeastern Indiana, the above 500 KW direct connected Murray steam turbine generator set has given its owners entire satisfaction. The turbine is equipped with every device necessary for minimum of attention including steam turbine driven auxiliary oil pump. The generator and exciter may be furnished to match existing electrical equipment in your plant.

Units in this size may be furnished either direct connected or geared as preferred with performance and operation equally trouble-free.

There is a Murray representative ready to help you with design and lay-out information.

MURRAY *also produces*

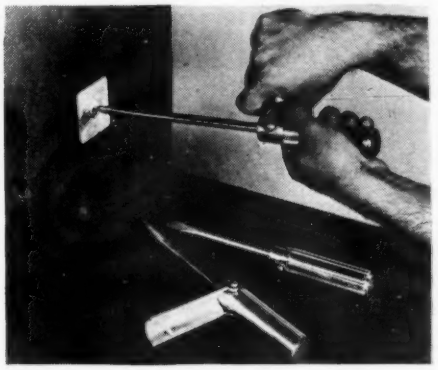
Mechanical Drive Turbines—Horizontal and Vertical Reduction Gears of the high speed type Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
Builders of Steam Power Equipment for Three Quarters of a Century

New Equipment

(*Continued from page* 132)

clockwise rotation at far end. Motors, both 1/30 and 1/100 hp, come with No. 20 8-in. lead wires, plastic insulated, pulley equipped. **Lear, Inc, 110 N Ionia Ave, NW, Grand Rapids, Mich.**



Screw Driver

TRIPLE-PURPOSE ALUMINUM-HANDLE screw driver, *Tuffy* contains an extra power arm that serves as a lever element for overcoming rust-bound screws. Lever arm folds back into handle to form a standard screw driver, but at full length it provides a horizontal hand support that allows full hand and body pressure. Screw driver comes with drop-forged steel blade, 5x$\frac{1}{4}$, 6x$\frac{5}{16}$, 8x$\frac{3}{8}$ in. **Swallow Airplane Co, Inc, Wichita, Kan.**

Bearing Grease

NONDRYING, NONCAKING and non separating grease serves ball and rotor bearings in horizontal or vertical operation. Dependable, manufacturer claims, for all speeds up to 3600 rpm over a range of 13 to 176 F, grease comes in an 8-oz nasal-spouted tube, which fits into a $\frac{1}{8}$-in. pipe coupling. **Westinghouse Elec Corp, PO Box 1017, Pittsburgh 30, Pa.**

Industrial Brake

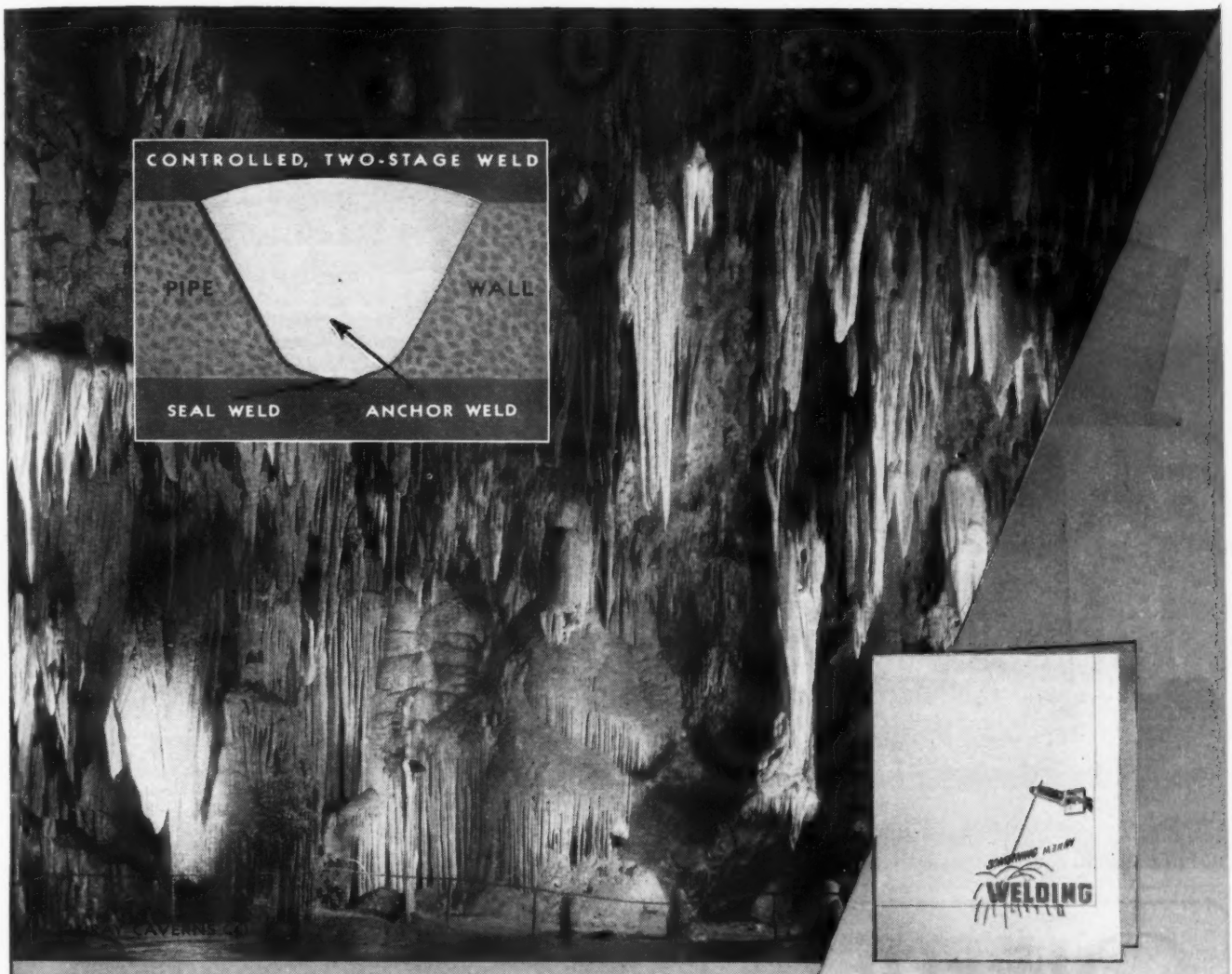
SELFCONTAINED, MULTISTAGE DIAPHRAGMS actuate through interconnections four adjustable shoes that bear against brake drum. Actuating medium is compressed air which by its amount controls braking effort. **Linderman Devices, Newburgh, N. Y.**

Fluorescent Lamp

INSTANT ILLUMINATION, double lamp life and mellow light are advantages advanced by manufacturer for *Safreen* fluorescent lamp. Initial units are available at present to commercial and industrial users. **Duro Test Corp, North Bergen, N. J.**

Liquid Filter

FINNED WIRE-CLOTH INSERT ASSEMBLY consists of inner and outer radial forms in which outer-form filtering medium is crimped and



No Luray Cavern Look

TO BUTT WELDED JOINTS*

Stalactites and stalagmites are beautiful to see in an underground cavern but similar protrusions inside of fusion butt welded pipe joints have obvious dis-advantages. Icicles of metal can be eliminated by the use of backing rings, but these too have many dis-advantages. Westport Joints made by a patented method of Controlled, Two-Stage Welding assure "penetration without protrusion"; i.e. strength through the pipe wall to the root of the weld with a smooth contour at the base of the weld . . . Our bulletin "Something New in Welding" tells the complete story. Write for it today. And remember, while our shop pre-fabricated piping can be made with any type of joint, we believe you'll prefer and specify the Westport, after you read our bulletin.

WESTPORT JOINT

*MADE WITHOUT BACKING RINGS BY THE MITCHELL-WESTPORT METHOD

(PATENTED)

W. K. MITCHELL & CO., INC.
2944 ELLSWORTH STREET
PHILADELPHIA 46, PA.
SINCE 1899

MITCHELL

PIPING FABRICATORS AND CONTRACTORS

*Before you buy any *Breechings... Get a*

CONNERY CONSTRUCTION *estimate!*

★ Connery Construction is electrically welded; Accordion-type Expansion Stiffener makes it buckle and warp proof, air and moisture tight. Let us tell you more about it for your jobs.

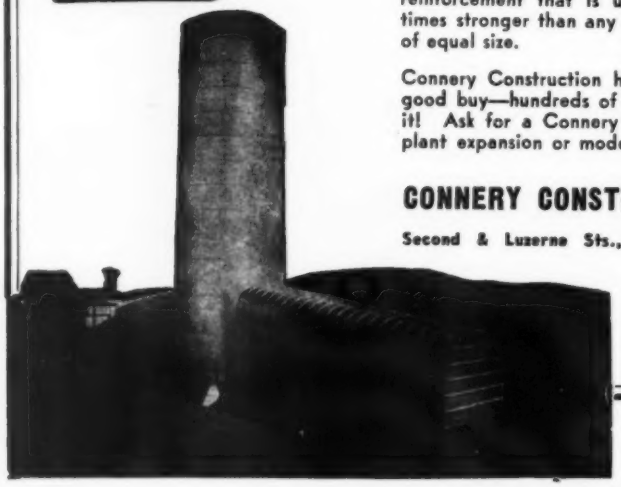
Much of the ability of Connery Construction to deliver long, air-tight, moisture-tight service comes from the use of Connery's "V" type stiffeners, cold pressed into the sheet metal from which the breechings or ducts are formed.

This improved Connery Expansion-Stiffened construction, plus electrically welded joints, eliminates buckling and warping—provides reinforcement that is uniform and many times stronger than any structural member of equal size.

Connery Construction has always been a good buy—hundreds of installations prove it! Ask for a Connery bid on your new plant expansion or modernization job.

CONNERY CONSTRUCTION CO.

Second & Luzerne Sts., Philadelphia, Pa.



SIMPLIFY *and* **SAVE** *in your coal handling, with* **SAUERMAN SCRAPERS**

ONE MAN OPERATION under clean attractive conditions, assures low cost, rapid and *efficient* handling of every ton of coal in and out of storage. Sauerman Scraper System builds a perfect homogeneous pile as high as desired. No segregation combustion hazards of air pockets. Maintenance is simple. There's a Sauerman Scraper for every capacity.

A small Sauerman scraper bucket is pictured above at outer edge of high storage pile with 1200-lb. load of coal which it has hauled smoothly across pile. An instant after picture was taken, bucket had dumped its load and was on its way back to pick up another load.

Get Catalog with Specifications

Liberally illustrated with photo views of Sauerman Machines in operation. Much useful data. Wire or Write

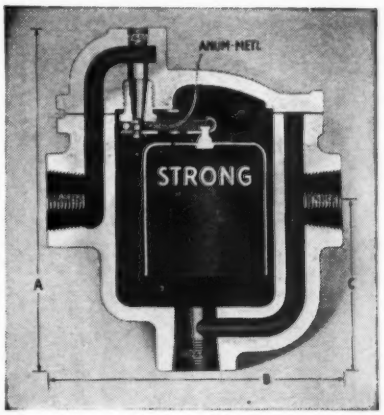
SAUERMAN BROS., Inc.

562 So. Clinton St., Chicago 7, Illinois

clipped over the inner form. Top and bottom plates and gaskets inclose assembly with a bolt construction. *Slip-On* insert permits use of any filtering material capable of crimping, which makes *Staynew Model ELS* filter adaptable to various liquids, its manufacturer claims. **Dollinger Corp, Rochester 3, N. Y.**

Nickel-Steel Tubing

CORROSION-RESISTANT, HIGH-NICKEL steel tubing maintains good physical properties at low temperatures to —320 F, manufacturer states. Containing high 9%-nickel content product is reputed to resist corrosion, alkaline attack, low-temperature embrittlement. At —320 F Charpy impact values of 25-ft-lb are reported. **Babcock & Wilcox Tube Co, 85 Liberty St, New York, N. Y.**



Steam Trap

ORIFICE THROAT, SCREWED-IN VALVE SEAT and level construction constitute features of these improved inverted bucket traps. Trap lies below inlet pipe at all times. Orifice avoids turbulence, reduces choking by flash steam. Traps come in three body sizes up to 1¼ in. in both standard and thermal design. **Strong, Carlisle & Hammond Co, 1392 W 3rd St, Cleveland 13, O.**

Hand Tachometer

CENTRIFUGALLY OPERATED broad-range precision tachometer registers close readings, it is claimed, on precisely calibrated graduations. Unit comes in four models: *A*, from 30 to 12,000 rpm; *B*, 45 to 18,000; *C*, 60 to 24,000; *D*, 120 to 48,000. **George Scherr Co, 200 Lafayette St, New York 12, N. Y.**

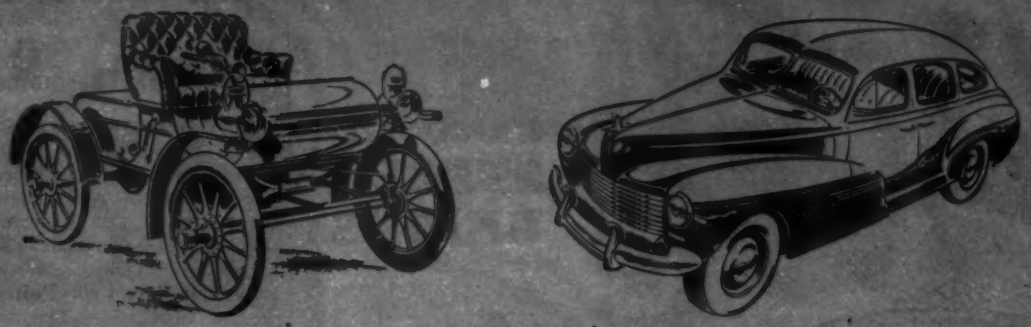
Fuel Loss

SMALL, SLIDE-RULE DEVICE, available upon request, contains fixed scales listing six grades of fuel, sliding rule carrying CO_2 and flue-temperature readings. Information provides data for converting heat loss to fuel loss. **Hays Corp, Michigan City, Ind.**

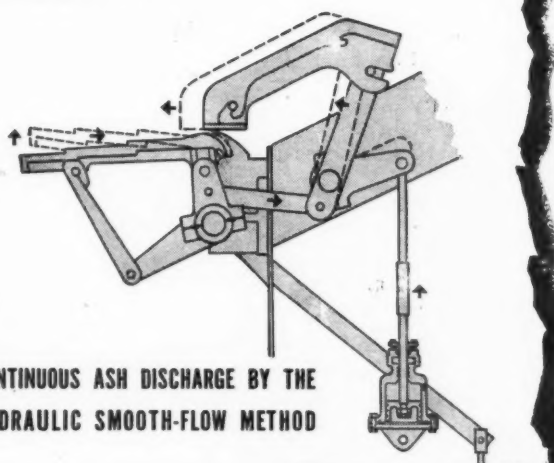
Water Cooler

HEAVY-DUTY NONBREAKABLE stainless steel forms one-piece cabinets and top plates for glass-wool insulated *Coolstream* electric

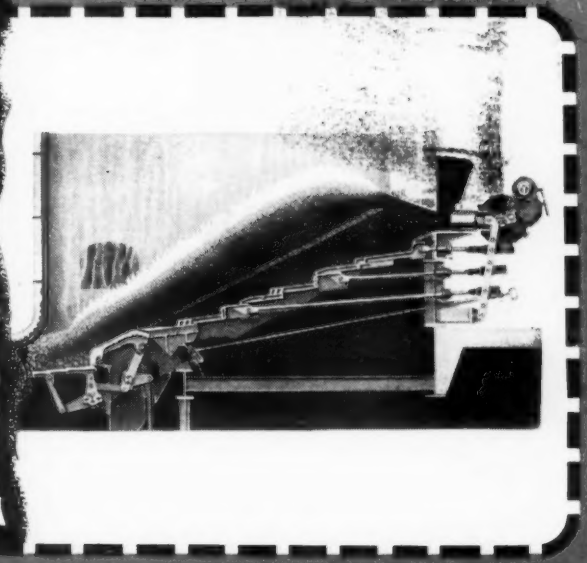
What a Whale of a Difference!



. . . BUT THE BASIC PRINCIPLE IS STILL THE SAME



CONTINUOUS ASH DISCHARGE BY THE HYDRAULIC SMOOTH-FLOW METHOD



IMPROVEMENTS Make the Difference in Æ Taylor Stokers, Too!

CONSTANT IMPROVEMENTS have kept the flexible, versatile Æ Taylor Stoker two jumps ahead of fluctuating fuel prices, shifts in coal availability and strides forward in power plant economy. Just one of the advanced engineering features that adds to its 40-year success story, is the smooth-flow hydraulic drive which brings new efficiency to continuous ash discharge.

The smooth action of powerful hydraulic cylinders has been harnessed to provide simple, direct operation of the overfeed sections of the stoker—moving ash all the way to the tip of the ash discharge plate, at a predetermined, uniform rate. Independence from the main stoker drive eliminates complex mechanisms and the need for frequent adjustment. You get positive ash discharge *continuously* as required by fluctuating steam requirements and the variable ash content of coals.

Find out more about this and other *improved* features of the Æ Taylor Stoker—how they can be adapted to consistently produce more steam at top efficiency in *your* plant. Write for Catalog R-A or ask for specific engineering assistance.

Other Æ Products: Æ-Perfect Spread Stoker, Lo-Hed Hoists, Marine Deck Auxiliaries, Hele-Shaw Fluid Power.

Æ

TAYLOR STOKER

AIR-COOLED & WATER-COOLED

The Only Underfeed Stoker with *all* these Features IN COMBINATION!

1. Continuous Self-Sealing Ash Disposal
2. Movable Ash Discharge Plates
3. Smooth-Flow Hydraulic Drive on Rear End
4. Independent Pusher Controls within ⅛ inch
5. Unique Sure-Feed Coal Agitators
6. Silent-Shift Spur Gear Planetary Power Transmission

AMERICAN ENGINEERING COMPANY

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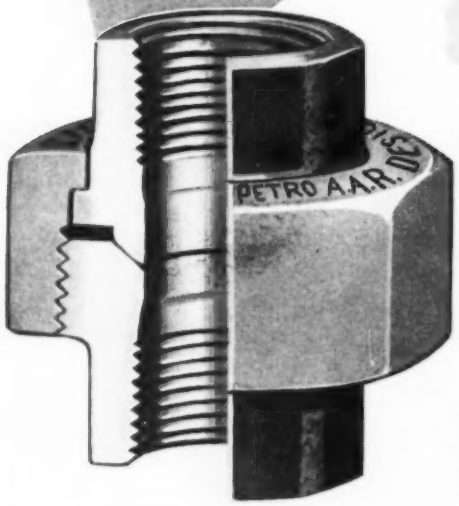
there is

ENDURANCE

in FORGED STEEL UNIONS



SIZES ⅛" TO 3"

Petro

AMERICA'S MOST UNIVERSALLY USED UNION

PETRO unions have integral steel to steel seats. Made to A. A. R. design. 600 lbs. S. W. P.-2000 lbs. C. W. P. Extra heavy ends and nut with nut threads that are permanently lubricated. The seats are machined and cold rolled.

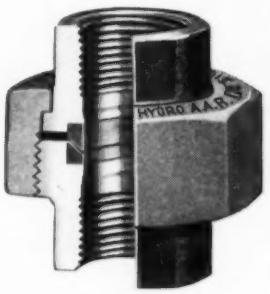
A PARTIAL LIST OF PROVEN SERVICES

Pressures from a vacuum to 3000 lbs.: Temperatures from 100° below zero F. to 1000° above zero F.: On Steam, Gas, Air, Oil, Gasoline, Ammonia, Chemicals, and any service in which Steel or Wrought Iron Pipe is Used.

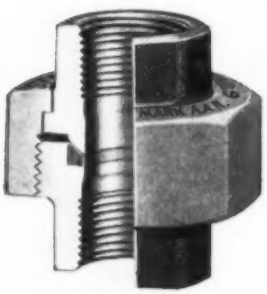
Hydro

THE ONLY FORGED STEEL UNION WITH TWO BRONZE SEATS

Made to A. A. R. design. 600 lbs. S. W. P.-2000 lbs. C. W. P. HYDRO unions have extra heavy ends and nut, with the nut threads permanently lubricated. The bronze seats are completely fused to the steel and are then machined and cold rolled.



SIZES ¼" TO 3"



SIZES ¼" TO 3"

Mark A.A.R.

AMERICA'S FIRST STEEL UNION

The MARK A. A. R. unions have bronze to steel seats. Made to A. A. R. specifications. 600 lbs. S. W. P.-2000 lbs. C. W. P. MARK A. A. R. unions have extra heavy ends and nut with the nut threads permanently lubricated. The bronze seat is completely fused to the steel and then machined and cold rolled.

WRITE FOR PAMPHLET AM-67 • ORDER BY TRADE NAME FROM YOUR JOBBER

ORIGINATORS AND PIONEERS OF FORGED STEEL UNIONS

CLAYTON MARK & COMPANY

1900 DEMPSTER STREET • EVANSTON, ILLINOIS

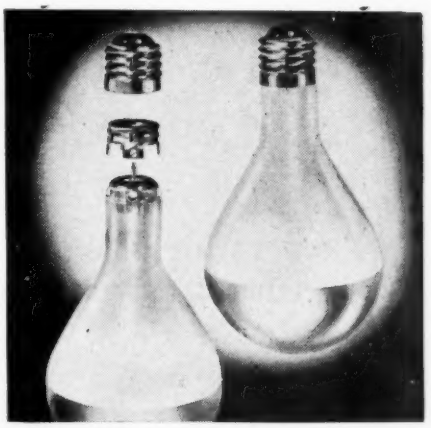
water coolers. Powered by hermetically sealed *Kelvinator* unit, water temperature is controlled by adjustable thermostatic control using *Freon*-12 for a refrigerant. **Coolstream Corp, 55 W. 42 St, New York, N. Y.**

Industrial Thermometer

LENS FRONT, YELLOW BACK and engraved scale make *H-B Midget* thermometers easy to read, manufacturer claims. Available in both straight and angle forms, 5 and 7 oz respectively, with straight thermometers 9 in. overall, units come in scale ranges from —30 F to +700 F. **H B Instrument Co, 2518 N Broad St, Philadelphia 32, Pa.**

Welding Electrode

MACHINABLE WELDS IN CAST IRON, manufacturer states, develop from use of *Ni-Rod* electrode. Another new electrode, the 133, an 80-20 nickel chromium for *Inconel*-clad steel is also available. **International Nickel Co, 67 Wall St, New York, N. Y.**



Lamp Base

THREADED COLLAR AND DETACHABLE BASE eliminate base cementing and neck strapping. *Superlok* contains collar claws that grip the neck of the glass bulb, thus making a permanent lock. All standard-line lamps, of this manufacturer, from 300 watts up, will have this construction. **Wabash Appliance Corp, 345 Carroll St, Brooklyn 31, N. Y.**

Rubber-Covered Wire

LIGHTWEIGHT, CENTERED CONDUCTORS result from return of natural rubber for wire insulation. *Laytex* covering depends for proper application on (1) immersing conductor in a liquid-rubber bath or (2) extruding the plasticized form on the conductor. **U. S. Rubber Co, Rockefeller Center, New York, N. Y.**

Brake Control

TRIPLE-DUTY CUSHIONED STOPS develop, manufacturer states, from use of *Type HM* crane-bridge brake. Unit has (1) transformer and selenium rectifier for ac operation (2) resistors for dc to give 12-v dc for brake operation. Foot-controlled hydraulic brake regu-

The Miniature Men of Sellersville, Pa.

ONE OF THE REASONS 6 OUT OF 10 PICK U. S. GAUGES

MODELMAKER'S SKILL TO Nth PRODUCTION-POWER

Among other things, a U. S. gauge is a marvel of columns, arbors, pinions, dowel posts, inserts and rivets, so small as to be the envy of a patient modelmaker, and accurate to a whisker. All parts of this type are produced to close tolerances in huge quantities on automatic machines. And all are made right in U. S. G.'s own Sellersville plant.

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U. S. Gauge is famed for making 99-44/100% of its own parts . . . from the raw material level. Many of these manufacturing steps are exclusive with U. S. Gauge. Even more vital to you is U. S. G.'s *Manufacturing Control*, a system that keeps tabs on materials, manufacturing, assembly, calibration, testing, inspection . . . assures you the quality preferred by over 6 out of 10 experienced buyers.

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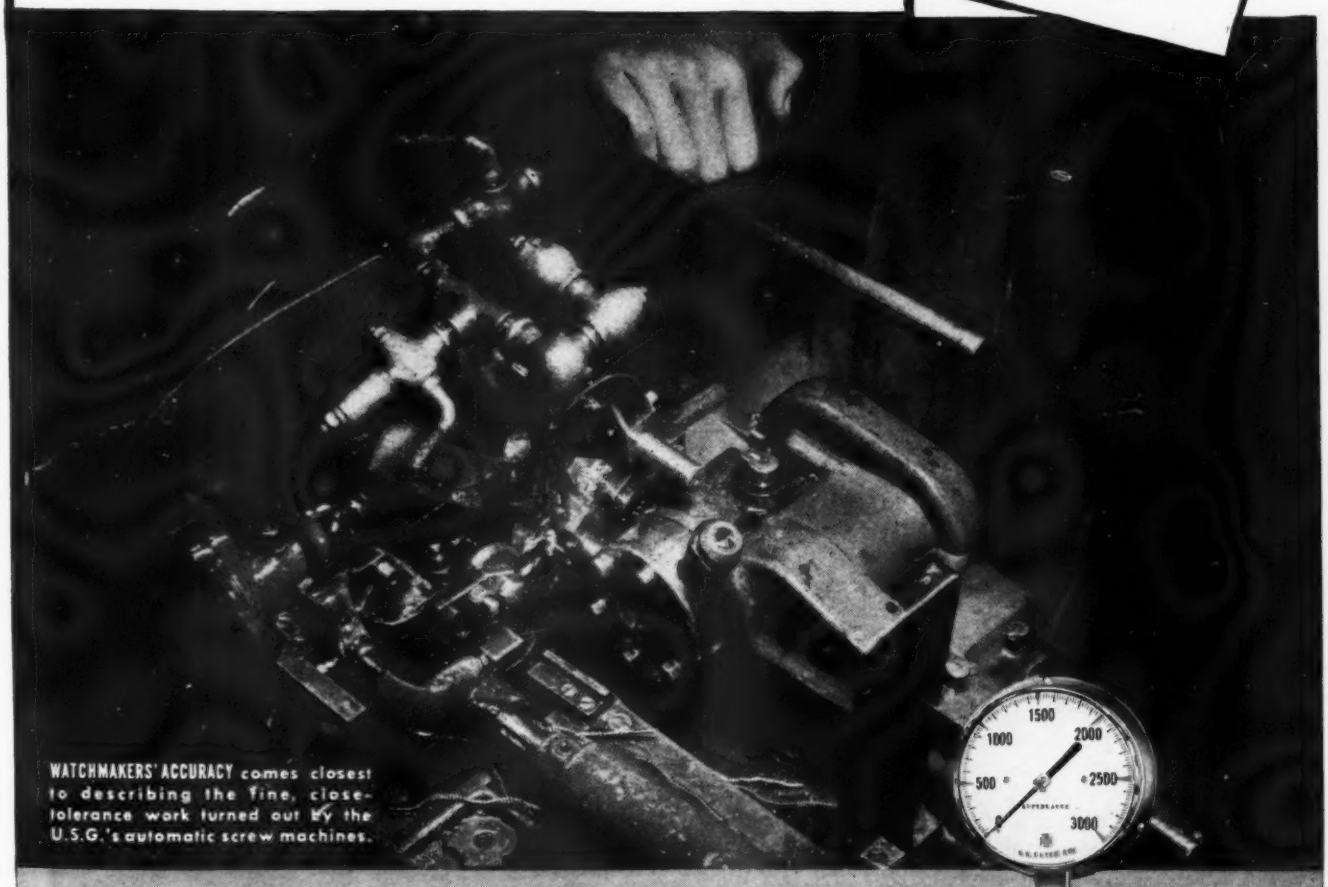
Men of many titles in dozens of industries have swamped us with requests for the big new U. S. Gauge catalog. 102 pages. Packed with facts about gauges, gauge manufacture, gauge movements. Designed especially for quick reference, ease in ordering. Your name on your business letterhead will reserve your copy of this catalog.



WATCHMAKERS' ACCURACY comes closest to describing the fine, close-tolerance work turned out by the U.S.G.'s automatic screw machines.

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DIVISION OF AMERICAN MACHINE AND METALS, INC.

SELLERSVILLE, PA.

Manufacturers of Pressure, Temperature, Flow, and Electrical Measuring Instruments

U.S. INSTRUMENTS Tell The Truth

USG

DAVIS PRESSURE REGULATORS

. . . custom made for ANY job!

● *Left: Davis No. 401 Pilot-operated Regulator.*

● *Left, Below: Davis No. 16 Diaphragm actuated, Weight Loaded Regulator.*

✓18 Different Types . . . Sizes to 24 Inches

✓For Steam, Air, Oil, Gas, Water...Pressures to 1500 lbs.

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To obtain maximum efficiency in your pressure regulator installation, it is absolutely essential to have the proper valve for each application. Pressure reduction requirements are as dissimilar as finger prints, and solution of these often-complex problems requires proper size, capacity and operating characteristics, as well as proper design and dependable construction.

The Davis Pressure Regulator line is COMPLETE; no matter how special the application, Davis builds a regulator that will do the job. Every Davis product is constructed and tested to meet the requirements of each individual order.

Davis engineers can solve your pressure reduction problem quickly and efficiently. Literature and selection charts prepared in easy-to-use form are yours for the asking.

For additional information, write today for Bulletin 100 A. **DAVIS REGULATOR COMPANY**
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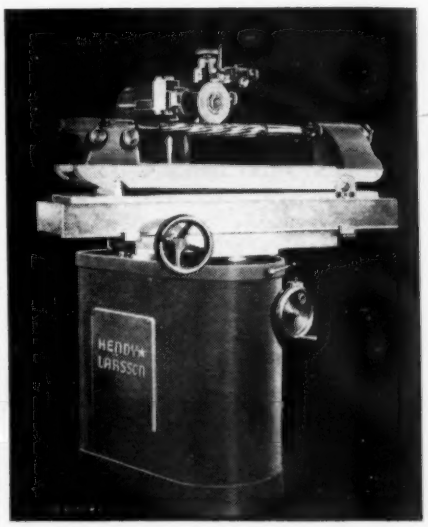
DAVIS VALVES **DAVIS REGULATOR COMPANY**

lates service stops while compressing parking-brake setting-spring. Power failure releases setting-spring, which stops the crane at a predetermined rate. **Wagner Electric Corp, 6400 Plymouth Ave, St. Louis 14, Mo.**

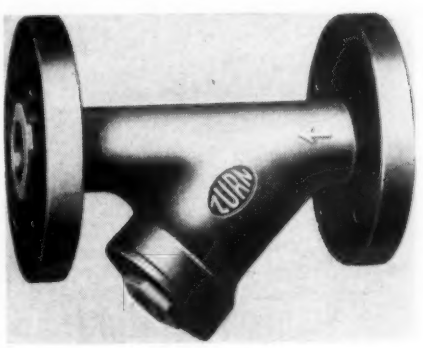
Wire Coding

PERMANENT, LEGIBLE, quickly applied identification made possible, manufacturer claims, by use of precut *Quik-Labels*. Various combinations of 14 colors provide 200 code cards from which to draw individual labels for adherence to flat or round surfaces. **W H Brady Co, 2910W E Linwood Ave, Milwaukee 11, Wis.**



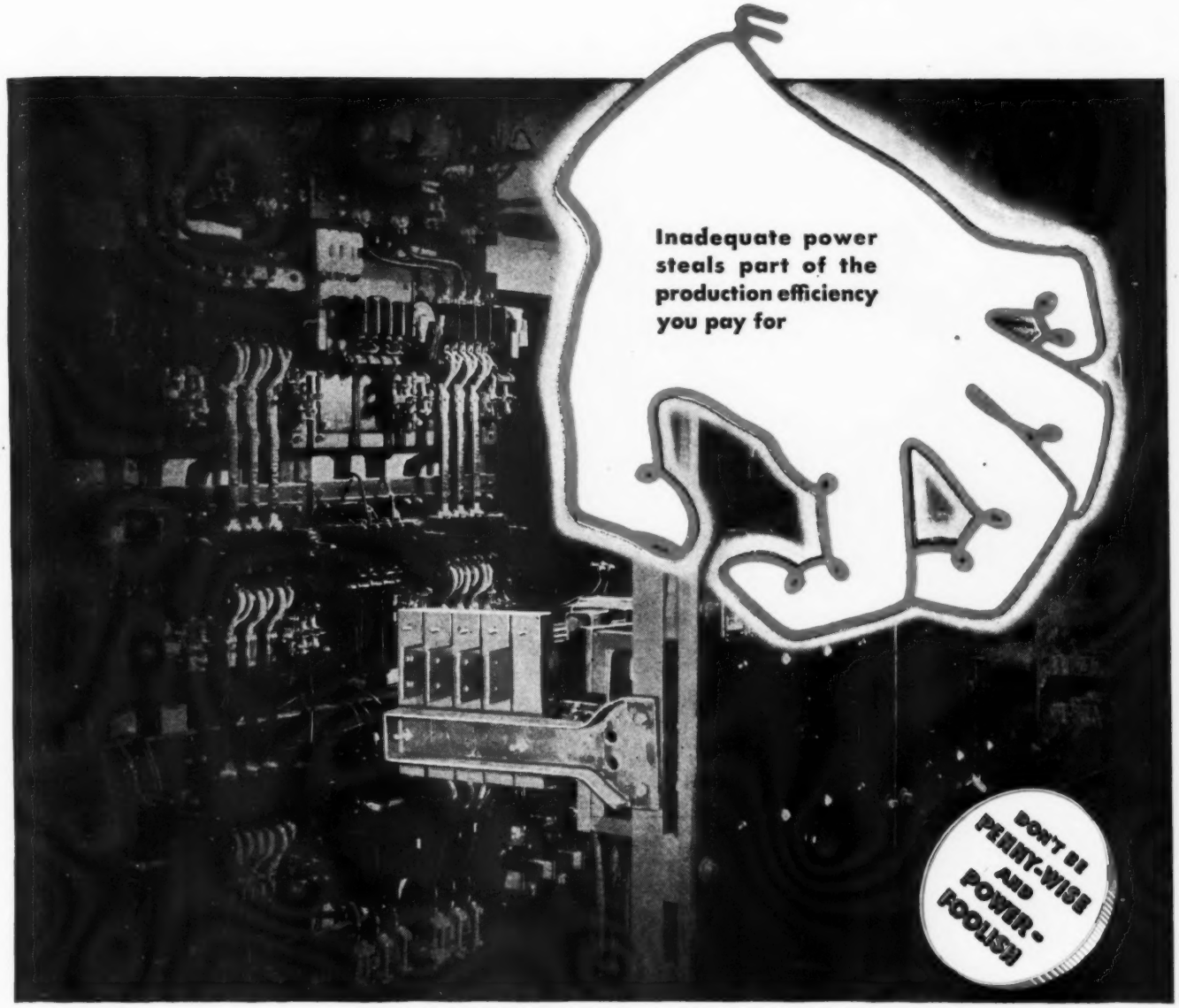
Tool Grinder

DIAL ASSEMBLY AND CURVED BACK-SUPPORT promote ease in setting-up and long life of *Standard Hendy-Larrson Reamer and Cutter Grinder*. Sine bar enables grinding of taper reamers to accuracies of 0.0001 in., manufacturer claims. Adjusting dials, clearance slide and carbide-tipped locating finger in the cutter wheel allow continued accuracy of clearances, it is further said. **Joshua Hendy Iron Works, Sunnyvale, Calif.**



Pipe Strainer

SLEEVE-EQUIPPED VIBRATION-RESISTANT Y-strainer removes injurious material in pipe line. Hydrostatically tested, strainer basket may be magnetized to withdraw harmful metal particles. *Y-strainer* comes in cast



Backward wiring handicaps advanced equipment

...Wire ahead

DON'T HOBBLE new, improved equipment for the sake of saving a few extra dollars worth of wiring.

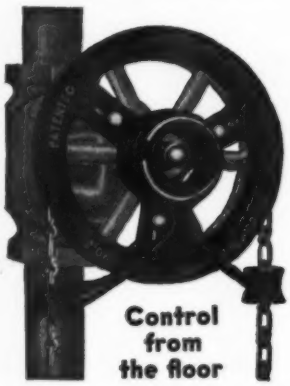
Remember, to get peak efficiency from postwar production equipment wiring must come first—foresighted wiring to provide for greatly expanded power needs to come.

Check your wiring plans now. Avoid costly alteration shutdowns later. Call in your consulting or plant power engineer, electrical contractor or power salesman. Hear what *they* say about the wisdom of soundly planned wiring and service equipment. Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company. General Offices: 25 Broadway, New York City 4. Chicago Office: 20 North Wacker Drive 6. Sales Offices in Principal Cities. 42300

✓ *Check your wiring plans before they check you!*

ANACONDA **ANACONDA WIRE & CABLE COMPANY**

Make Your Overhead Valves SAFE and Easy to Reach---



Control from the floor

With the Babbitt Rim for Valves you eliminate danger and banish the step ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

BABBITT STEAM SPECIALTY CO.
New Bedford, Mass.

The COMPACTNESS and arrangement versatility of the IMO pump are illustrated by this tandem mounting of two separate IMO pumps on a common shaft, such as can be used on a Diesel, where one pump is needed for lubricating oil and the other for scavenging oil. Where space is limited, IMOs fit.

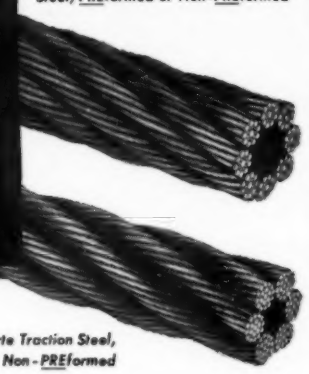
For information send for Catalog 1-122-P

IMO
PUMP DIVISION OF THE
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

A complete line!

MACWHYTE ELEVATOR ROPES

PREformed or Non-PREformed



8 x 19 Macwhyte Special Traction Steel, PREformed or Non-PREformed

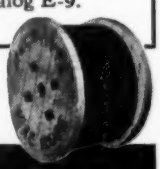
6 x 19 Macwhyte Traction Steel, PREformed or Non-PREformed

• Made of selected, tested steels from wire drawn in Macwhyte's own mill under constant metallurgical control.

Your Elevator Maintenance Man can get safe, dependable, economical Macwhyte Ropes from Macwhyte Distributors and Mill Depots conveniently located throughout the country. Macwhyte's complete line of hoisting, counterweight, compensating, and governor ropes makes it easy to get the correct ropes for your equipment.

Send for this complete listing of Macwhyte Elevator Ropes in handy, vest pocket size. Ask for Elevator Catalog E-9.

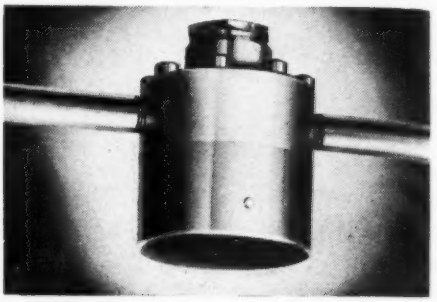
MACWHYTE COMPANY
2944 Fourteenth Avenue
Kenosha, Wisconsin



NO. 823-E

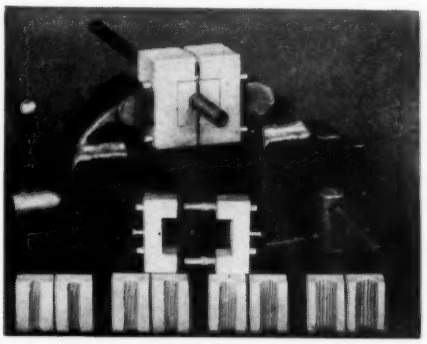
Specify **MACWHYTE ELEVATOR ROPES**
Low-Cost-Per-Car-Mile Ropes correctly designed for your Elevators

bronze, steel, semisteel or cast iron, with or without a cleanout plug or a threaded blowoff connection. **J A Zurn Mfg Co, Erie, Pa.**



Pressure Regulator

STAINLESS-STEEL PARTS, homogeneous structure of *Duraluminum* gives rugged strength to compact unit. Small 2-lb, 2¾x3¼-in. *Mity-Mite* regulator handles air and gases of initial pressures up to 3500 psi with adjustable control range from 5 to 1500 psi. Special models handle up to 5000 psi. **Grove Regulator Co, 6547 65th St, Oakland 8, Calif.**



Pipe Grip

VARIOUS-SIZED HARDENED-STEEL inserts slip into two light-alloy retainer blocks that permit thin-walled pipe to be worked in any vise. *Nip-Grip* allows horizontal or vertical positioning by holding pipe member with pins. Inserts, ⅛, ¼, ⅜ and ½ in. size, allow operation without marring or crushing surface or threads. **J A Campbell Co, 645 E Wardlow Rd, Long Beach 7, Calif.**

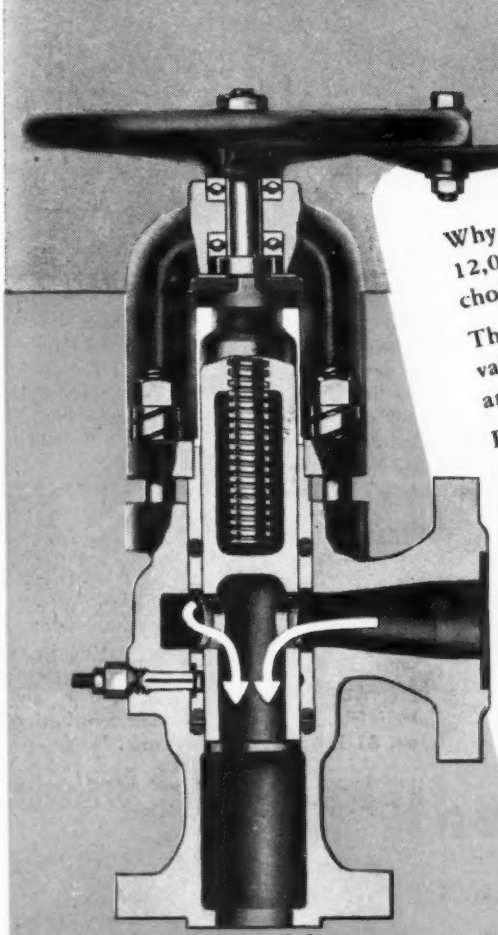
Hand Tachometers

DIRECT-READING WELL-DAMPED centrifugal-operated hand tachometer comes in four models covering ranges from 30 to 12,000, 45 to 18,000, 60 to 24,000, and 120 to 48,000 rpm. **Herman H Sticht Co, Inc, 27 Park Place, New York, N. Y.**

Moisture Indicators

SMALL, SENSITIZED, roll- or strip-form labels change color with humidity. Color change, definite and reversible, shows blue-green when dry, pink when moisture approaches point of molding, corrosion or sogginess in a material. *Hygrolabel* mounts on a protective backing so that when (1) not removed it may

Better because it's Seatless



Yarway Type C Seatless Angle Valve, open position.

Why has this blow-off valve become "standard" in over 12,000 boiler plants? Why is it today the universal choice of leading engineers for new boiler installations?

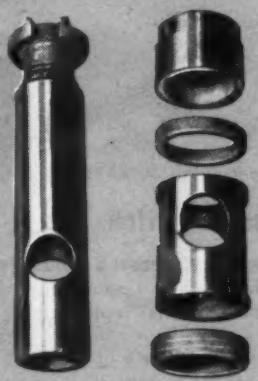
The answer is in the engineering reason behind the valve. It is *SEATLESS*. There is no seat to score, wear and clog with mud, scale and dirt.

Power plant operators hailed this seatless-design valve more than 25 years ago when it was first introduced. It eliminated a source of continual trouble and expense common with conventional type blow-off valves.

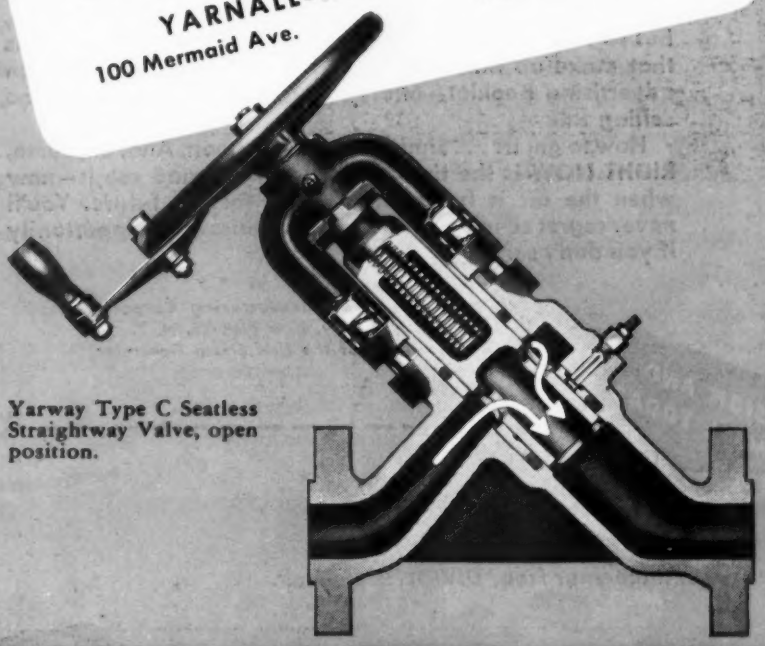
Since then constant mechanical and metallurgical research, aimed to meet new and more rigid service requirements, has made improved Yarway Seatless Blow-Off Valves the last word in insurance against boiler blow-down troubles.

See Yarway Blow-Off Valves, hear the seatless principle explained by Lowell Thomas in Yarway's color motion picture "There Is An Engineering Reason." It's available without charge for group showings. Write today.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia 18, Pa.

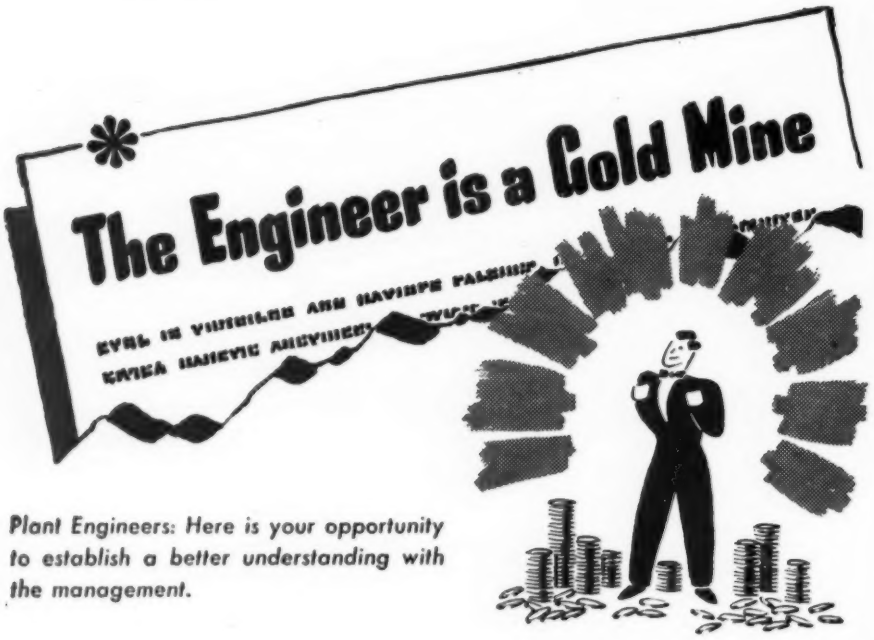


Yarway Type C Nitralloy Plunger, Glands and Improved Packing Rings.



Yarway Type C Seatless Straightway Valve, open position.

YARWAY BLOW-OFF VALVES



Plant Engineers: Here is your opportunity to establish a better understanding with the management.

Send for the 36-page free book "Dividends from Your Power Plant" and read the section on page 8 — "The Engineer is a Gold Mine".

In it you will find important, down-to-earth *facts* about your job—facts that the front office *ought* to know, but has probably never clearly realized.

It lists some of the many and varied things a practical plant engineer has to know and constantly use.

It shows the important relation of this knowledge to product costs and profits.

It is probably the first clear statement ever made for management on what an engineer understands and does.

It is written in non-technical terms that executives easily grasp.

Read "The Engineer is a Gold Mine" and pass it along to your chief to read. Not only will that section interest him, but so will the nine other practical power plant discussions that make up this book. And remember—this is NOT an advertising booklet—offers nothing for sale, contains no selling talk.

How to get it? . . . Simply mail the coupon. And, of course, RIGHT NOW is the time to get this book and *use* it—*now* when the air is full of new plans for the future. You'll never regret sending for it—you may miss a big opportunity if you don't send.

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1860 Broadway, New York 23, N. Y.
Manufacturers of the Unit Steam Generator

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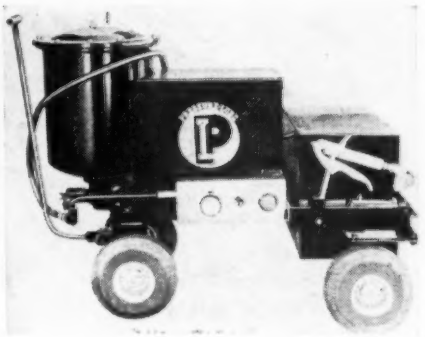
P-1-46 .....

PREFERRED UTILITIES

be placed among powdered, granulated or flaked material without fear of contamination and (2) removed it may be affixed to any surface. **Eljay Enterprises, P O Box 891, Newark 1, N. J.**

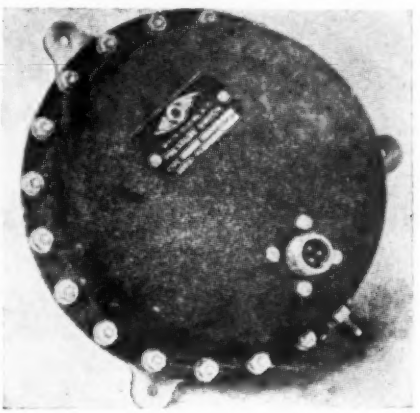


Portable Greaser

SELF-POWERED PRESSURE-FED grease system reduces hand-greasing requirements. Capable of developing 12,000 psi from a battery or gasoline-engine power service. Pressurelube unit can be equipped with grease guns if desired. **Pressurelube Inc, 609 W 134th St, New York 31, N. Y.**

Plastic Coating

IMPERMEABLE, AIR-DRYING, THERMOPLASTIC FILM resists most acids, all alkalies. *Corrosite* is reputed to be impervious to chemical fumes, salt spray, acid ground conditions, with further qualities of high abrasion resistance, temperature resistant at 250 F, and electrolytically immune. **Baker Synthetics, Inc, 51 E 42nd St, New York, N. Y.**

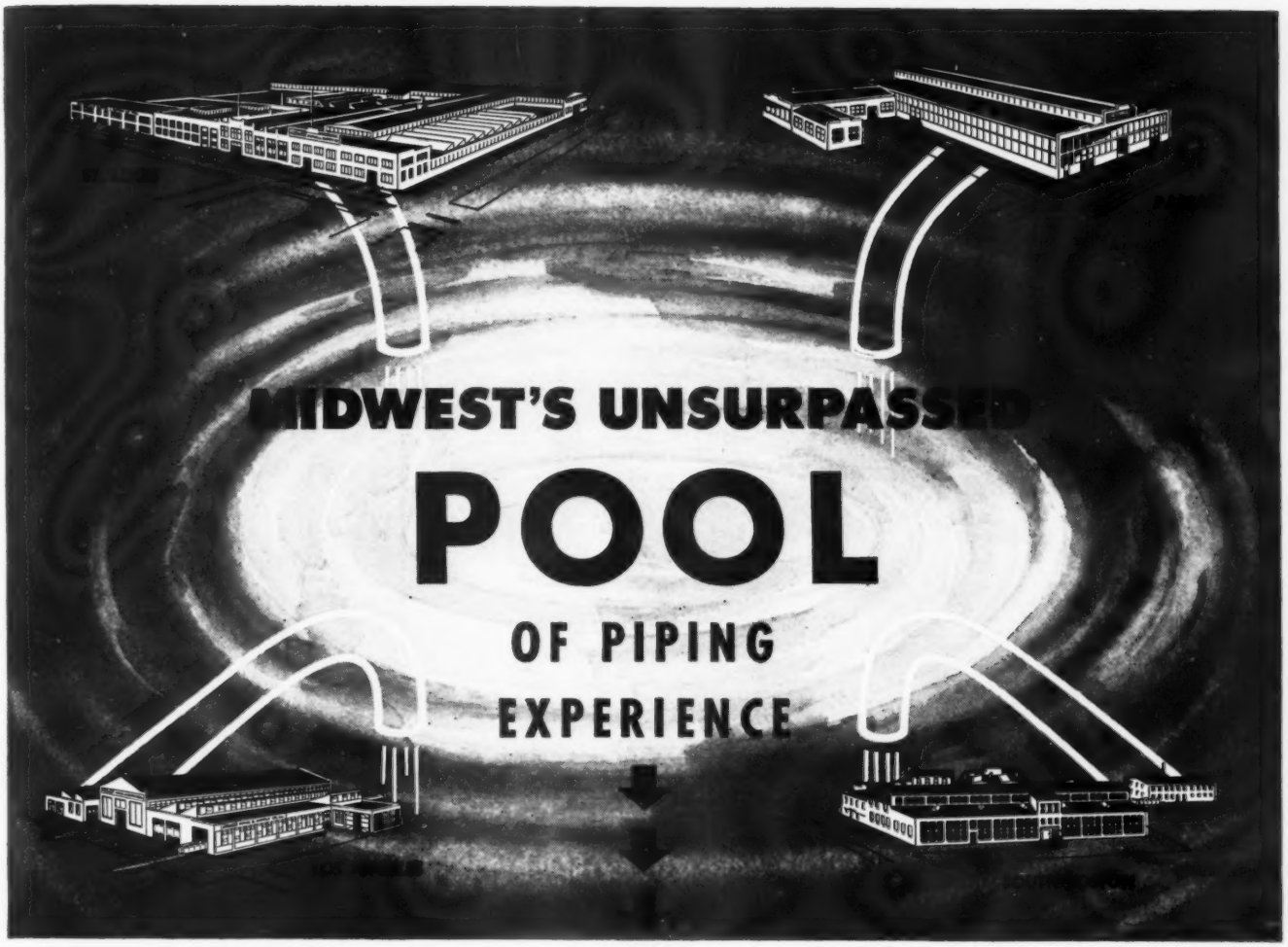


Pressure Switch

DIAPHRAGM - OPERATED PRESSURE - SENSITIVE switch shows a sensitivity of 1/100 in. of water on stationary applications, its manufacturer states. Two knobs furnish adjustment for desired pressure of operation on this former automatic control of fighter-plane intercooler flaps. **Aerotec Co, White Plains, N. Y.**

Flexible Tubing

FIRE-RESISTANT, TOUGH, DURABLE thermoplastic coating covers a spring-steel helix core that allows bending and sharp turns even to a figure-8 knot with a reduction of



ASSURES the User BETTER PIPING

Continuous interchange of experience data and manufacturing information between Midwest's four pipe fabricating plants results in a pool of piping experience that is unsurpassed by any other organization.

Each plant is fully equipped to do a complete job of pipe fabricating—is staffed by piping experts of long experience and high qualifications. Each plant is always striving to improve its product. A friendly rivalry acts as a stimulant.

Information on new processes and techniques, solutions to unusual piping problems, and generally useful data are exchanged between these plants. One plant will develop an improvement in welding procedure for a difficult alloy . . . another will build a new fixture for saving time in welding . . . etc. For many years this exchange has been building up an unsurpassed pool of piping experience and "know how."

This is just one of several reasons why Midwest can do a better piping job for you . . . whether you want a simple bend or piping for an entire plant installed without divided responsibility.

MIDWEST

PIPING & SUPPLY CO., INC.

Main Offices: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles • Subsidiary: Lunsden & Van Stone Co., South Boston 27, Mass. • Sales Offices: New York 7—30 Church St. • Chicago 3—645 Marquette Bldg. • Los Angeles 33—320 Anderson St. • Houston 2—239 Shell Bldg. • Tulsa 3—832 Mayo Bldg. • Atlanta 3—Rhodes-Haverty Bldg. • South Boston 27—436 First St.

PIPING FABRICATORS AND CONTRACTORS

. . . and Compare

A cold Brickseal-coated brick unaffected by emery wheel. Uncoated brick rapidly disintegrates.

BRICKSEAL

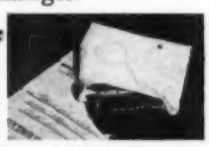
PROTECTS REFRACTORIES AGAINST ABRASION

REFRACTORY BRICK of same quality – one coated with Brickseal and the other uncoated – were forced against an emery wheel turning at 1800 rpm. The Brickseal-coated brick glowed red from the friction and was not cut or affected, while the uncoated brick was easily disintegrated.

Brickseal consists of high fusion clays and metal oxides combined in oil. Furnace heat burns away the oils and vitrifies the clays and metals. Brickseal prevents cracking, spalling and slagging regardless of temperature changes.

TRY IT YOURSELF

Two bricks bonded together and partially coated with Brickseal will be mailed to you on request.



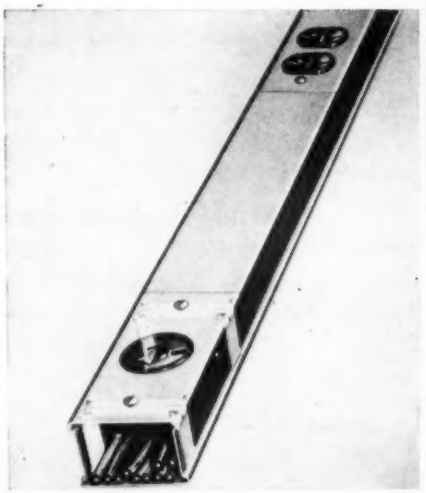
BRICKSEAL
REFRACTORY COATING
5800 So. Hoover St., Los Angeles, Calif.
1029 Clinton St., Hoboken, New Jersey

only about one fourth of its free-air area. *Spiratube* comes in 3, 4, 4¾, 5, 6, 8, 10, 12, 14 and 16 in. dia; 10-, 15- and 25-ft lengths equipped with *Warner* couplings for ready joining. A 15-ft section of 8 in. dia with couplings, weighs 10 lb, 3 oz. **Warner Brothers Co, Bridgeport 2, Conn.**

Mobile Crane

RUBBER-MOUNTED MANY-PURPOSE crane embodies power shovel, trench hoe, dragline and clamshell. *Wayne Crane*, its manufacturer claims, can travel, boom, swing and hoist at the same time. It has a self-leveling chassis that permits operation on uneven ground, and a full-vision cab.

Cab revolves on a 48-in. ball-race outside the swing gear. A 62-hp gasoline engine drives all four wheels and the hoisting mechanism. Oversize hoist drums reduce cable wear. Crane has four travel speeds up to 15 mph, a short wheelbase, 7 ft, 8 in., so that it complies with all highway restrictions; no permits required. **American Steel Dredge Co, Inc, Fort Wayne, Ind.**



Electrical Duct

TWO-PIECE SURFACE RACEWAY employs a lay-in principle. Use of a patented arch bridge within the raceway (1) allows maximum wire capacity (2) retains wires during installation (3) locks the snap-on cover and (4) enables installation of various devices.

Underwriter Laboratory rating for *Surface-*

STOP FISH

BY ELECTRONICS

This patented fish control method employs modern electronics in overcoming a serious operating and maintenance problem. Fish of all sizes are kept at a *safe distance* from intake structures, or screens, by the use of an Electronic Control Unit. This equipment, generating special electrical impulses, energizes an electrode system designed and engineered for your particular fish control problem.

The Burkey Electric Fish Screen has been thoroughly proven through years of service in Condensing Water Intakes, Hydroelectric Plants, Water Systems and Industrial Pumping Installations. DOES NOT STUN OR KILL FISH.

Recommended by State Conservation Officials.

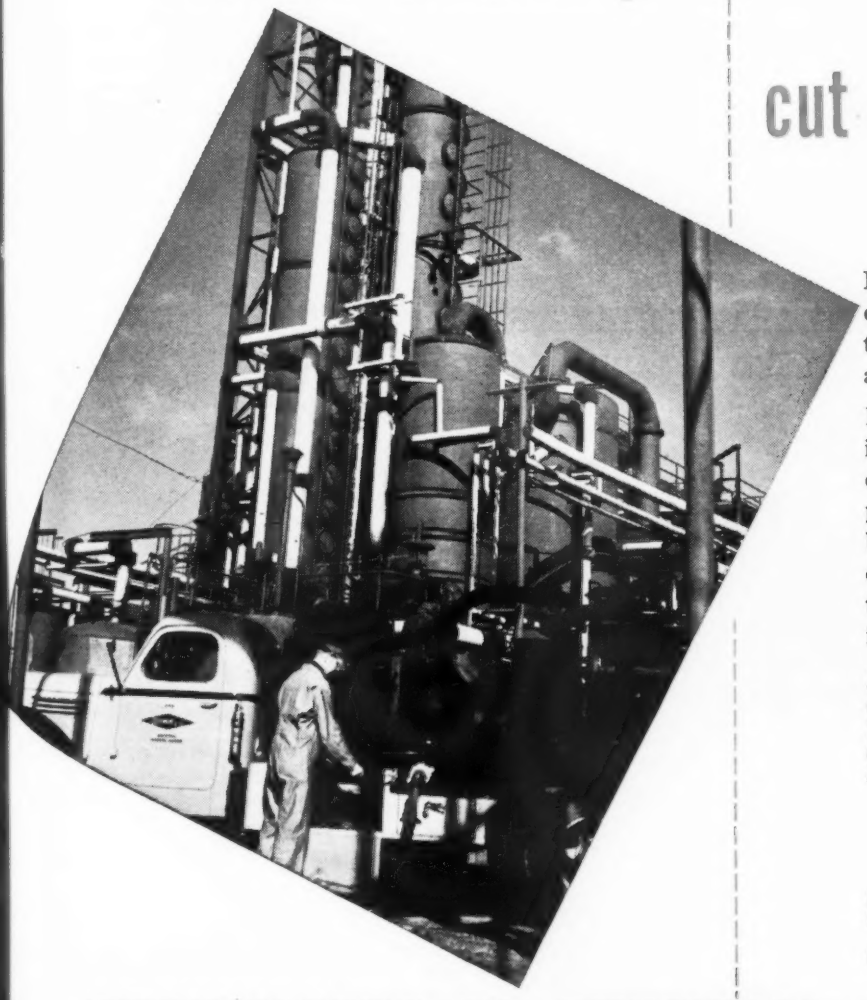
Free literature and quotations upon request.

Electric Fish Screen Co.

1130 No. Poinsettia Place
Hollywood 46, California

DOWELL

restore efficiency



cut operating costs

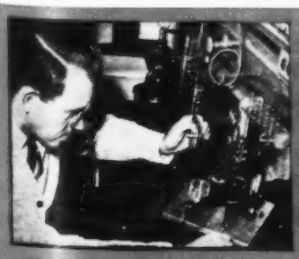
Leading refineries reduce operating costs and quickly restore designed operating efficiency through Dowell's *chemical method* of removing accumulated scale and sludge from heat exchangers.

Dowell specialists do the entire job. They pre-inspect the equipment to be cleaned. They chemically analyze samples of deposits found in *your* plant. And after this careful preparation they bring with them the proper chemicals and adequate equipment to completely *control* every stage of the treatment and to insure effective removal of the insulating deposits.

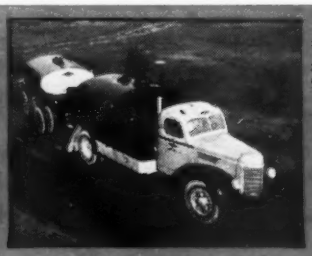
For complete details, call the nearest Dowell office for a free estimate. Ask for your copy of "More Power to America's Industry"—new color booklet which explains and illustrates Dowell's thorough chemical cleaning service.

DOWELL INCORPORATED
Subsidiary of The Dow Chemical Company
GENERAL OFFICE; TULSA 3, OKLAHOMA
New York • Philadelphia • Baltimore • Buffalo • Cleveland • Chicago
St. Louis • Houston • Kansas City • Wichita • Mt. Pleasant, Michigan
Salem, Illinois
Long Beach, Casper: Dowell Affiliates—International Cementers, Inc.

SPECIALISTS IN CHEMICAL CLEANING SERVICE



Dowell's experienced industrial engineers are backed by the complete research and technical facilities of The Dow Chemical Company.



Dowell's equipment is modern and complete—scientifically designed. Treating stations and chemical warehouses conveniently located.

Dowell cleaning solvents are "tailor-made" to fit each job. All ingredients are of the highest quality, chosen for best results in your plant.

DOWELL

FOR INDUSTRIAL CHEMICAL SERVICE

HERCULES
SEAMLESS COPPER
FLOATS

GUARANTEED

TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure carefree maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

Gives You
LONG, TROUBLE FREE SERVICE!

Fig. 1635

"STANDCO"
PILLOW BLOCKS

The attractive "Standco" Pillow Block shown above is sturdily built and is offered in a wide range of sizes. Babbitted and broached bearing surfaces, accurately machined faces. Can be amply lubricated.

Write for Bulletin

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA., BOX 577
Boston • Chicago • Detroit • Indianapolis
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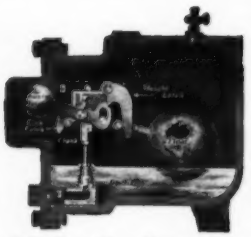
You Can Trust

NICHOLSON TRAPS

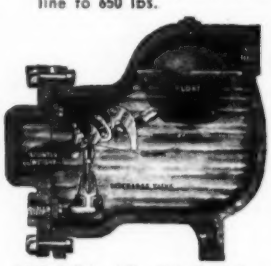
To Solve Tough Drainage Problems

For every power & process purpose.
Enormous drainage capacity.
Fast, positive action.
Stainless steel where it counts.
Sturdily built to take abuse.
Plant-proved efficiency promoters.

Reference-File CATALOG 444
It's a helpful standard reference on drainage problems



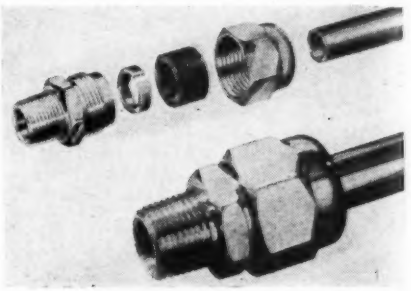
MODEL WO. Steam pressures to 500 lbs.; air, gasoline to 650 lbs.



MODEL JR. Weight-operated. For steam, air, gas pressures to 200 lbs.

W. H. NICHOLSON & CO. 125 OREGON ST. WILKES-BARRE, PA.

auct without devices is a capacity of six No. 6 or ten No. 8, 12 or 14 wires. With auxiliary devices, capacity becomes four No. 6, five No. 8, or ten No. 10, 12 or 14 wires. **National Electric Products Corp, Pittsburgh, Pa.**



Tube Fittings

STRONG, LEAKPROOF, FLEXIBLE JOINTS develop from a solderless fitting. *Flexigrip* consists of (1) body (2) gripping ring (3) synthetic-rubber gasket and (4) nut. Fitting makes up by (1) slipping nut with gasket and ring inside over any plain-end tube cut to desired length (2) inserting tube end into the body as far as it will go and (3) tightening the nut. This tightening action compresses the ring to a tight grip and molds the gasket around the ring to produce a leakproof seal. Tube fittings come in brass, aluminum or steel. **Gustin-Bacon Mfg Co, Kansas City, Mo.**

Welding Compound

PASTE-FORM READY-FOR-USE welding compound serves small-diameter low-current electrodes. *Strike-Easy* comes in one-lb glass jars for use on any metal with any type electrode. **General Electric Co, Schenectady.**

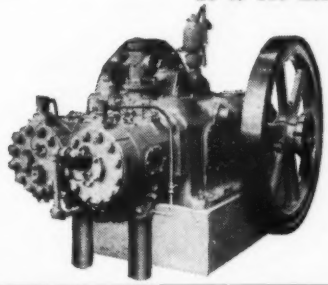
POWER's History

POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam*, which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals, namely, *Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trade's Magazine, Home Study for Electrical Workers and Steam Electric Magazine.*

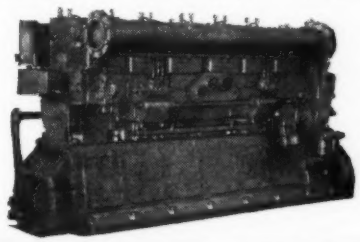
In 1908 POWER absorbed *The Engineer's Review, of Cleveland*, and *The Engineer*, of Chicago, the latter being a consolidation of *The Safety Valve, Lord's Power and Machinery Magazine, The Stationary Engineer, Steam Engineering and The Mechanical Engineer.* When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer.* The title was condensed to POWER in 1911. All rights to the preceding titles reserved.

TYPE GA ..... 1 or 2 cylinders
25 to 110 horsepower

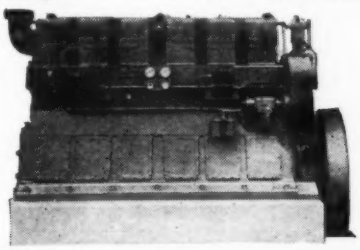


TYPE EN ..... 6 or 8 cylinders
Atmospheric ..... 135 to 400 horsepower
Supercharged ..... 185 to 550 horsepower

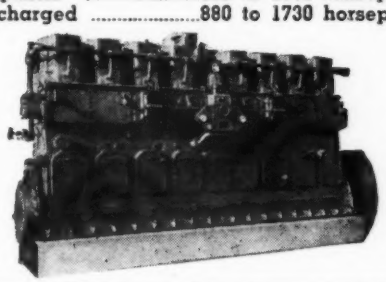
TYPE GS ..... 5, 6, 7, or 8 cylinders
Atmospheric ..... 290 to 750 horsepower
Supercharged ..... 310 to 1000 horsepower



TYPE JS ..... 6, 7, or 8 cylinders
Atmospheric ..... 410 to 930 horsepower
Supercharged ..... 550 to 1260 horsepower



TYPE LS ..... 6, 7, or 8 cylinders
Atmospheric ..... 650 to 1280 horsepower
Supercharged ..... 880 to 1730 horsepower



Cooper-Bessemer DIESELS

★ Reliable ★ Efficient ★ Enduring

If your power requirements fall between 25 to 1800 horsepower, there is an efficient, long-lived Cooper-Bessemer diesel exactly suited to your needs. Cooper-Bessemer diesel generating sets and direct-drive diesels are widely used throughout industrial America wherever low-cost power, simplified operation, and trouble-free performance under continuous service are essential.

A few of the Cooper-Bessemer diesels are shown here. All the vertical engines are available supercharged which affords up to 50 percent increased horsepower without increasing engine space requirements.

Particularly significant in industrial applications, Cooper-Bessemer diesels can be furnished to operate with equal efficiency on either gas or customary oil fuels, or on virtually any combination of both at will. They may be changed instantaneously from one fuel to the other at full load without even reducing speed.

This revolutionary Cooper-Bessemer development permits remarkable fuel economies. Gas fuel can often be supplied at sharply reduced cost throughout the long off-peak season.

If you are interested in reduced operating costs and year after year of dependable, uninterrupted power service, contact the nearest Cooper-Bessemer office for bulletins and complete details on the proper diesel set-up for your needs.

THE COOPER-BESSEMER CORPORATION

Mount Vernon, Ohio — PLANTS — Grove City, Penna.

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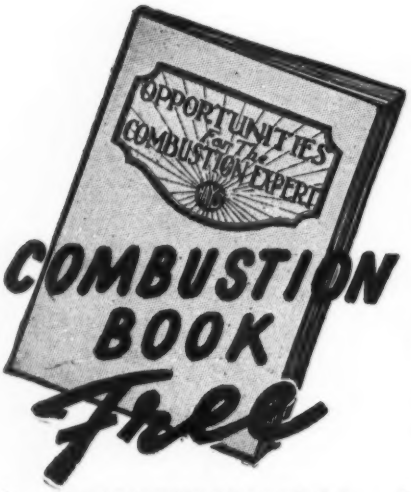
201 E. First Street, Tulsa, Oklahoma — 640 East 61st Street, Los Angeles, Calif. — 570 First Avenue, S., Seattle, Washington



LEARN THE SECRET OF BIG EARNINGS IN

COMBUSTION ENGINEERING

There are plenty of big jobs today in Combustion Engineering. Such jobs have always been big pay jobs—and today they are better than ever. High fuel and equipment costs means a greater demand for combustion trained men than ever before.

Do you want such a job? You can have it—if you will train for it. And that is *easy to do.* Just a little of your spare time is required for the simple, easy-reading, practical Hays Home Study Course in Fuel and Combustion engineering.

For 28 years we have specialized exclusively in such training. Today, Hays trained men are more in demand than ever. Now is the time to do what hundreds of others have done who hold substantial positions of responsibility today.

Firms, like International Harvester Co., Armour and Co., Iron Fireman Mfg. Co., Cities Service (Oil & Power), send their men to us for training. They know that anyone can learn by the Hays method how to improve combustion efficiency as applied to Boiler Plant Operation, Fuels and Equipment.

Write for Free Book Now! Don't Delay! Mail Coupon Today!

You can't lose by getting the facts. We'll send our book, "Opportunities for the Combustion Expert" without obligation or expense to you. Learn how every lesson is administered by trained practical staff men who give the utmost in help and guidance. Get complete outline of course. Learn how to become a key man in Combustion. Send in the coupon now!

Hays Institute of Combustion
430 N. Michigan Ave., Chicago 11, Ill. (Dept. 11)
Our 28th Consecutive Year

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Please send me your Free Book "Opportunities for the Combustion Expert"—No obligation.

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Power News

(*Continued from page* 134)

to $19,215,000 levels its major cut at the project's transmission grid. With the exception of $730,000 to begin a 230-kv line from Oroville to Sacramento, where the municipal system has been seeking Shasta Dam power, all funds for lines were disallowed. This serves as a sharp curtailment in Reclamation's plans. That body envisages a transmission grid south to Tracy and back to Shasta substation by way of Stockton, Sacramento and Oroville, with the Shasta-Oroville line the only portion in operation. A western Shasta-Tracy line of two 230-kv loops depended on allocation of funds in this appropriation and none were advanced.

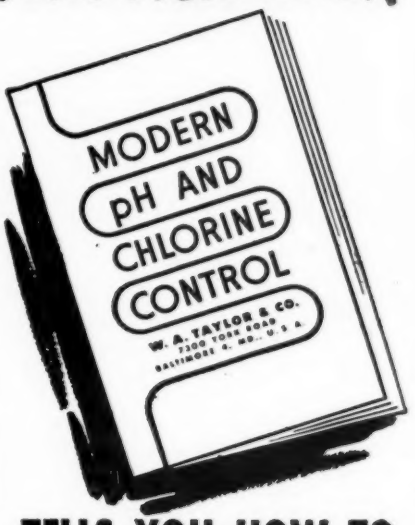
Studies of power and irrigation on the Kings River project, costing an estimated $97,000, were eliminated along with a $500,000 transmission line from Brush to Sterling to Holyoke, Colo. appearing in the Colorado-Big Thompson item.

An allowance of $480,000 for construction of a 141-mile 115-kv transmission line from Fort Peck Dam to Williston, N. D., was made in deference to its prominence as a main item in the Missouri River development program authorized for Army engineers and the Reclamation Bureau. Committee, however, disallowed funds for lines to serve private utilities, REA co-ops and irrigation districts with this expression: "Such lines and substations should be constructed by the agency which proposed to use the power."

The Army Engineers were refused all but a trifling amount, for the payment of damages, of $128,593,000 it had asked. The committee recommended further study on a number of projects included in the request especially those involving multi-purpose dams. "Such dams," said the committee, "may be thoroughly justified, but the committee is reluctant to recommend them without further inquiry into the merits of features not essential to protection against floods." In line with this reasoning $1,151,000 was dropped from the bill with a recommendation for further study before establishing funds for starting a number of projects authorized in various acts and treaties for distribution of water.

An item of $1,500,000 for construction of Hungry Horse dam was approved. Sometime ago its postwar construction was authorized on the South Fork of the Flathead River in northern Montana. Ultimately some generating capacity will be available at its plant but it is aimed

This New Book



TELLS YOU HOW TO MAKE PHOSPHATE DETERMINATIONS IN *2 minutes!*

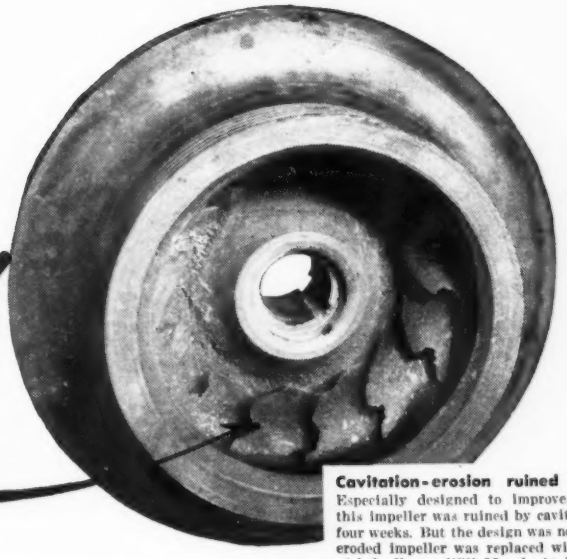
That's right . . . pH determinations in 60 seconds . . . phosphates in 2 minutes . . . *in any part of your plant.* And you will know the answers are right, for *accuracy is assured, as all Taylor Liquid Color Standards are guaranteed not to fade.*

Taylor LIQUITROL
THE MODERN METHOD TO CONTROL pH, CHLORINE AND PHOSPHATES

This new 88-Page Reference Book—just off the press. It fully describes Taylor Liquitrol Methods, procedures and outfits you need, such as Taylor Boiler Water Slide Comparators, High and Low Phos-Phate Slide Comparators, Poly Phosphate Comparator, the new Nitrate Comparator, Taylor Water Analyzer and others. Also applications of the Taylor Liquitrol Method in 34 industries, a feature you will find highly instructive. So don't guess about your boiler water. Know the right answers at all times. See your dealer or write direct *for your free copy of this new book today.*

W. A. TAYLOR AND CO.
YORK & ROGERS FORGE RDS. - BALTIMORE 4, MD.

Learn the story behind this damage



Cavitation-erosion ruined these blades. Especially designed to improve pump efficiency, this impeller was ruined by cavitation in less than four weeks. But the design was not abandoned. The eroded impeller was replaced with one made of a nickel alloy — "S" Monel. At last check, it was still in service after 2½ years — over a 3000% improvement!

A 5 MINUTE QUESTION AND ANSWER DIGEST ON CAVITATION-EROSION

THE PROBLEM

Q. What is meant by cavitation-erosion?

A. Cavitation-erosion (or simply "Cavitation") is the type of erosion caused by collapse of tiny bubbles in a liquid, with consequent hammering of the liquid against the metallic surface.

Q. Where may cavitation be encountered?

A. The inertia of a rapidly-moving liquid makes it tend to continue in a given direction rather than to follow the contours of the metallic surface over which it is flowing. This may create voids. The rush to fill them causes the cavitation. In power plants, for example, it is a particularly destructive phenomenon.

Q. Are these voids a complete vacuum?

A. No, the space is filled with vapor from the liquid and with dissolved gases that may be present.

Q. What causes the damage?

A. When the voids collapse, there results a pounding by the fluid comparable to the destructive force of tiny bullets impinging against the metallic surface. With thousands of voids collapsing every minute, the cumulative result is powerful enough to cause deformation and fatigue, and to remove films which might inhibit corrosion.

Q. How are cavitation and corrosion related?

A. Corrosion intensifies cavitation; and cavitation accelerates corrosion. Thus, a self-sustaining chain of destruction exists.

Q. How does corrosion intensify cavitation?

A. The roughened surface of a corroded metal affords greater opportunity for the formation and the collapse of voids.

Q. How does cavitation accelerate corrosion?

A. With many metals the initial corrosion rate is very rapid. However, the speed of the attack usually decreases due to the formation of protective films of the corrosion products. If these protective films are removed by cavitation, corrosion proceeds at an abnormal rate. *That is why use of corrosion-resisting metals and alloys is so important!*

THE REMEDY

Q. What important factors govern control of cavitation?

A. Laboratory and field studies indicate that the most important factors are:—

1. Proper design.
2. Resistance to corrosion fatigue.
3. Resistance to corrosion and freedom from pitting.
4. Tenacity of protective films, and speed of new film formation.
5. Strength, hardness, and ability of a metal to withstand over-stressing and to distribute locally-applied stresses.
6. Susceptibility to strain hardening.
7. Uniformity of grain structure.

Q. Why is design so important?

A. Poor design (inadequate streamlining) has proved to be the leading single cause of cavitation. And, its effect is intensified by a high velocity liquid flow.

Reprints of this advertisement are available upon request from The International Nickel Company, Inc.

Q. Doesn't this all boil down to developing the best design and selecting the right metal?

A. Yes! Both are very important and really interdependent. Sometimes a change in design will reduce cavitation. Sometimes, as in the impeller in the picture, the same design in a different metal will provide the remedy. *Consider both!*

Q. Design can be guided by skill and experience, but how can one be guided in selecting the right metal?

A. *Past performance!* Laboratory tests and field use have for years indicated that a group of high-nickel alloys should be considered wherever cavitation-erosion is a possibility.

Q. What is this group?

A. The corrosion-resisting INCO Nickel Alloys — nickel, Monel, "K" Monel, "H" Monel and "S" Monel. Their resistance to cavitation has been amply demonstrated by their successful use to replace other metals in high-speed propellers, pump impellers, hydraulic valves, agitators and in similar parts.

Q. Can INCO Nickel Alloys be used to build up parts that have already suffered cavitation-erosion?

A. Yes, and this ability is a big help on many repair jobs. For example, deposition of Monel or "K" Monel by arc-welding is an excellent way to build up eroded steel parts.

Q. How can more help be obtained on combating cavitation-erosion?

A. The International Nickel Company has made a special study of cavitation. If you have a problem involving this type of erosion, send full details of the application to: The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

C. H. WHEELER
OF PHILADELPHIA

STEAM CONDENSERS

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AIR EJECTORS

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MECHANICAL DRAFT
COOLING TOWER

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DECK MACHINERY

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MANUFACTURING Co.
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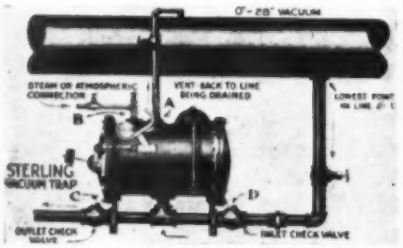
TURBINE USERS

Sterling

Vacuum Traps Will Drain Condensate From Lines Or TURBINES Under Any Stage or Vacuum, When Installed Below Lines or Turbines to Be Drained.



Operated by Either Low Pressure Steam or Atmosphere Depending on Type of Service Desired. Let us know your Problem.

Sterling Engineering & Mfg. Corp.
(Templeton Mfg. Co.)
110 Business Street
Hyde Park, 36, Massachusetts

primarily at providing considerable upstream storage for the Columbia River dams.

Davis Dam, on the Arizona-Nevada border, was granted $5,000,000 but $1,800,000 for a second 115-kv transmission line from Phoenix to Tucson was denied on the grounds that it is not an emergency measure.

Colorado-Big Thompson project received $5,000,000; Columbia Basin slightly more than $10,000,000. Reclamation's share of the Missouri River project was $10,269,000. Central Valley's $19,000,000 appropriation included $885,000 for installation of No. 1 and 2 generators at Shasta Dam where they have been returned after war service at Grand Coulee, along with $500,000 for construction of facilities to handle their output.

Midget Power Plant Furthers School Study

A complete, coordinated miniature power plant, developed by General Electric Co for engineering college laboratories, occupies a floor space of 10x15 ft and stands 6 ft high. Total weight of unit is 20,000 lb. Equipment consists of two 20-kw steam turbine-generators, a motor "load," 4-panel switchgear equipment, a condenser, miscellaneous piping and a foundation.

This compact power plant requires a supply of steam ranging from 125 to 250 lb and a source of circulating water for condensing purposes. Total 40 kw of generated power dissipates through a "load" imposed on an electric motor by a water break.

For two years about 3000 officers and men attended General Electric's Navy Destroyer Escort School, Syracuse, N. Y., for 4-week training periods. Instruction centered around a complete DE power plant set up in a factory building. Results based on demonstration proved so exceptional that this technique seems most worth while.

A miniature unit allows this demonstration technique and further gives such an over-all view of the complete operation that a broader understanding follows.

Growth Fosters Plant Expansion

Minneapolis-Honeywell Regulator Co plans a $3,500,000 expansion program that will involve additions to plants and machinery in four U. S. and Canadian cities. All this follows on the heels of a wartime purchase of a 10-story Minneapolis building and a 4-story addition to the main plant.

Under the expansion program, a new wing to the main plant will add 120,000 sq ft to present manufacturing facilities. Company operations in Chicago, Toronto and Philadelphia will be enlarged either by purchase of existing buildings or addition of floor space to present structures. These plans include expansion of the company's Brown Instrument Div in Philadelphia to enable it to handle an expected increase in demand.

Type DA-31 Pressure Control

MERCURY SWITCH
Hermetically sealed mercury switch is used. They cannot be affected by dust, dirt or corrosion; nor are they subject to open arcing, oxidation, pitting or sticking of contacts, all common causes of contact trouble. This switch will give better control service and longer control life.

BOURDON TUBE
(Hidden back of cover)
The Bourdon tube is the actuating element of the control. It is the oldest known, tried and proven element, having been used in gauges for many years.

OUTSIDE ADJUSTMENT
The outside double adjustment with the calibrated dial and pointers is a convenient feature, making it very easy to set the required operating range, plainly visible on the dial. All guesswork is eliminated.

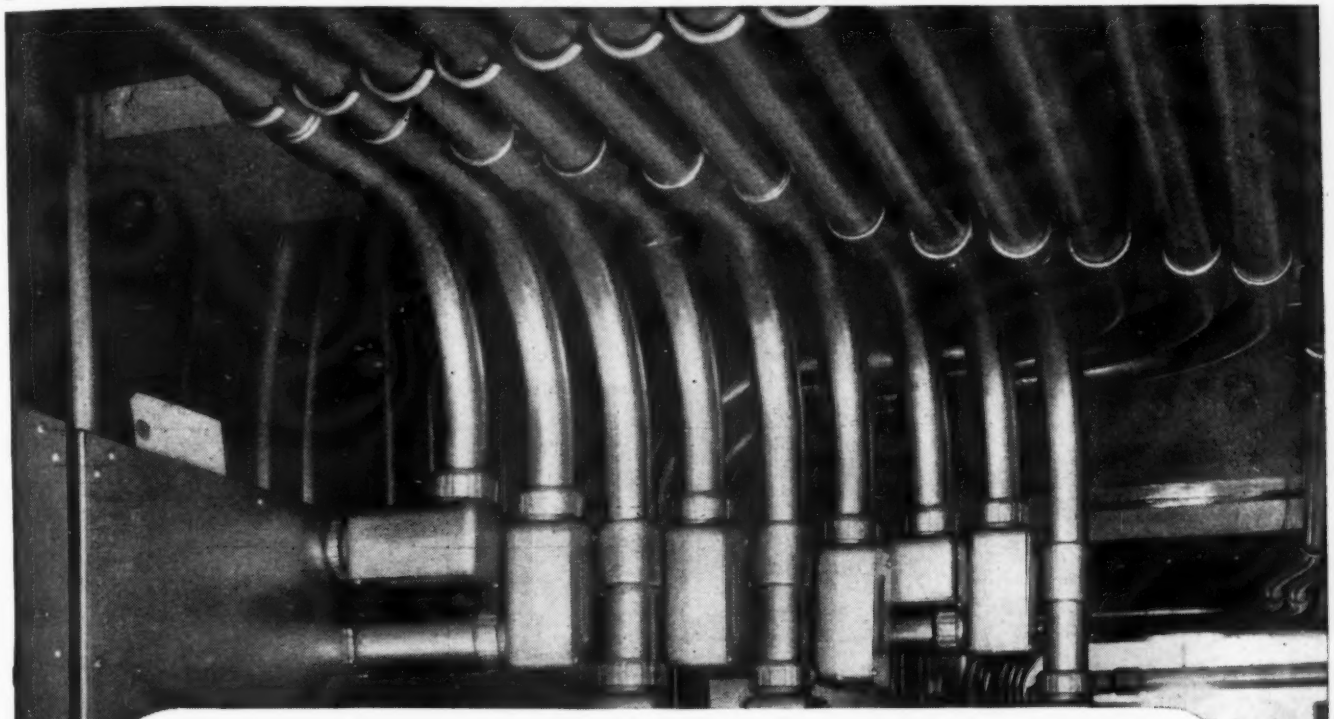
GLASS FACE
The glass face on the cover permits seeing the entire operation of the control in plain view. One can always tell whether the switch circuit is open or closed, a great convenience whenever servicing becomes necessary.

Consult Mercoid on pressure, temperature, liquid level or automatic mechanical control problems.

THE MERCOID CORPORATION
4201 Belmont Avenue
Chicago 41, Illinois

THE ASSURANCE OF DEPENDABLE SERVICE BUILT IN EVERY MERCOID CONTROL

FOR SAFETY'S SAKE . . . USE CONDUIT *(Full Weight Rigid Steel)*



Smart Long-Term Planning Demands SAFE Wiring Methods

A double responsibility confronts the electrical industry:

1. The obligation to replace temporary, unsafe wiring systems, installed according to "must do" emergency ideas, forced on industry by shortages and regulations.
2. The duty to install only assuredly safe wiring systems in all new construction.

Remember this: The only wiring system approved by the National Electrical Code as moisture, vapor, dust and explosion proof in hazardous locations is a standard-threaded rigid conduit.

With standard-threaded rigid steel conduit, such as Youngstown's Buckeye, again available through distributors, there is no reason not to provide dependable wiring protection.

Wherever there is moisture, or vapor, or excessive vibration, or possibility of corrosion, or accumlating dust and dirt, or danger of crushing or other mechanical injury, specify and use Youngstown Buckeye Conduit.

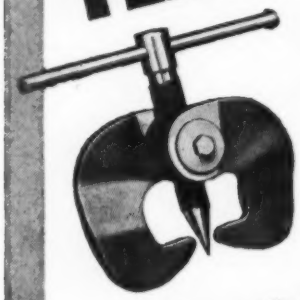
YOUNGSTOWN
THE YOUNGSTOWN SHEET AND TUBE COMPANY
YOUNGSTOWN, OHIO
Manufacturers of
CARBON - ALLOY AND YOLOY STEELS

Ask your distributor for:
Youngstown Buckeye Conduit - Pipe and Tubular Products - Sheets - Plates - Electrolytic Tin Plate - Coke Tin Plate - Bars - Rods - Wire - Nails - Tie Plates and Spikes.

Schedule your shut-downs with

FLANGE JACKS

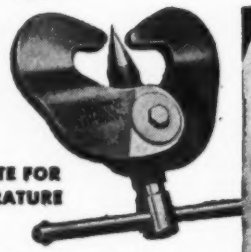
on any pipe line gasket replacement!

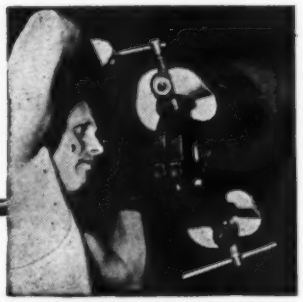


The only tool that takes the guesswork out of replacing gaskets, regardless of line pressure or location. Flanges are parted quickly and held in perfect alignment without damage to faces . . . shock and jarring of pipe lines are eliminated . . . there is no danger from flying wedges . . . no sparks caused by hammer blows. Flange-Jacks eliminate costly shutdowns, make possible fast, economical repairs in hard-to-get-at locations . . . offer maximum safety.

MAXIMUM PROTECTION to personnel and plant!

FLANGE JACKS are vital when replacing gaskets in presence of oil or gas fumes . . . eliminates hammer blows and sparks. FLANGE JACKS are a "must" in safety engineer specifications.





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T. G. PERSSON COMPANY

224 GLENWOOD AVE., BLOOMFIELD, NEW JERSEY

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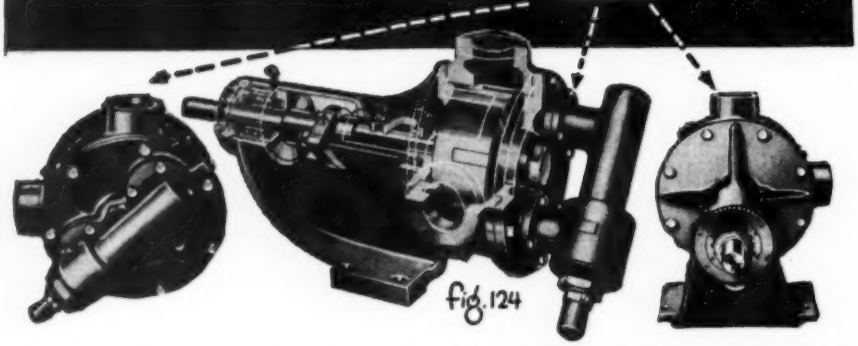


VIKINGS ARE 'TOPS' IN THE ROTARY PUMP FIELD

Viking Rotary Pumps outsell all others because Vikings are simple in design and ruggedly constructed to provide dependable, carefree service.

Write today for Bulletin Series 2500W which illustrates and describes Viking Rotary Pumps widely used in the power equipment field.

VIKING PUMPS — FIRST IN AMERICA

VIKING Pump COMPANY
CEDAR FALLS, IOWA

Marsh Receives Nicholls Award

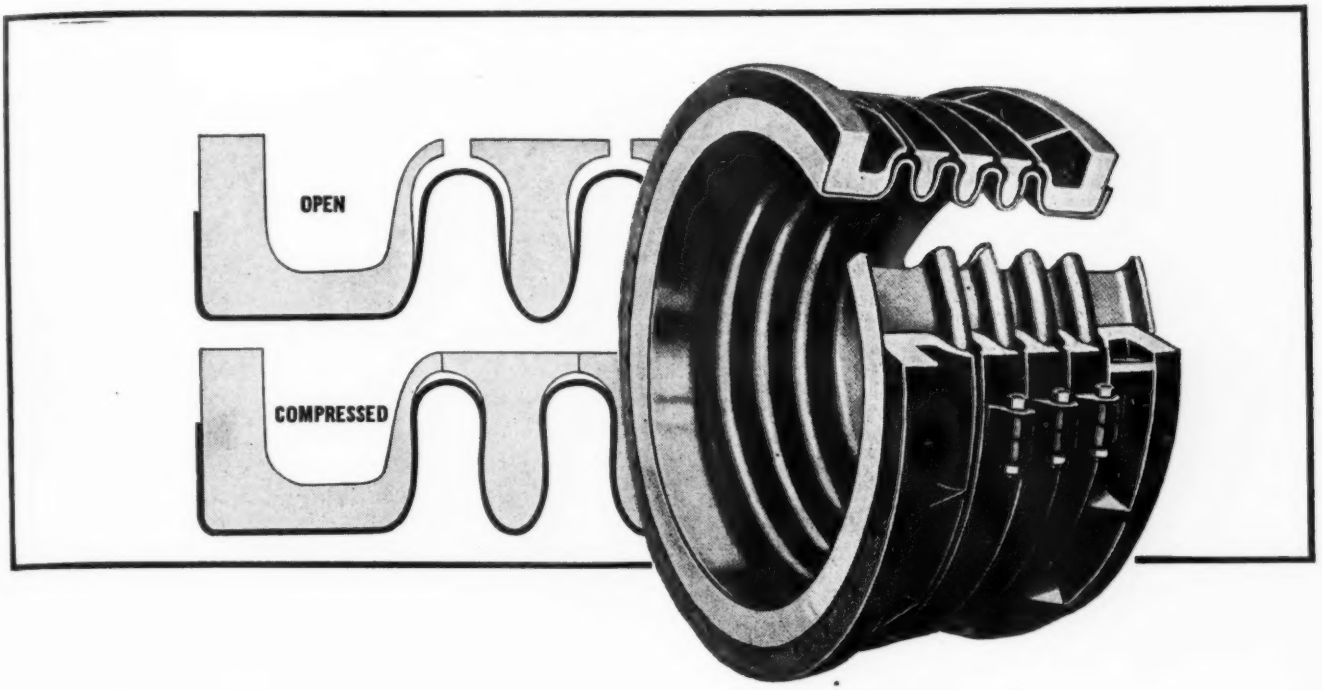
Thomas A Marsh, national industrial engineer for Iron Fireman Corporation, was singled out for the 1945 Percy Nicholls Award, a joint presentation of the fuels division of the American Society of Mechanical Engineers and the coal division of the American Institute of Mining and Metallurgical Engineers.

This award, the only one in the solid fuels field, is presented annually for "notable scientific or industrial achievement in the field of solid fuels." Its presentation was a highlight of a special fuels luncheon at the annual meeting of the ASME, November 26-29.

Marsh has long been a notable figure in his field. Since graduation from University of Illinois in 1904, he has directed his professional life to improving and bettering coal utilization. Many advances in design and application of coal-burning equipment have resulted from his efforts.

From 1934 Marsh has been affiliated with Iron Fireman, specializing in industrial stokers. He ranks as a pioneer in investigation and successful burning of lower rank coals. From his experience he has drawn material for engineering society papers and technical magazine articles. He is the author of *Combustion in the Power Plant* and *How to Buy, Sell and Burn Coal.*

Bridgeport Brass Co celebrated its 80th anniversary recently with a war-production record that had been awarded every possible Army-Navy E for excellence in production. Since 1865 the company has delivered brass and brass items for a host of products ranging from clocks and brass fasteners for hoops in hoop skirts in its early days to electric-furnace castings and the much publicized *Aerosol* dispenser for insect eradication.



DIRECTED FLEXING AND ALL-CURVE CORRUGATIONS

mean even distribution of stresses and longer life

LIKE a chain and its links, an expansion joint is only as strong as its weakest point.

Badger Joints are designed with ALL-CURVE corrugations to prevent stresses from localizing in pockets, junctions, or against straight sides.

As a further assurance of uniform all-over flexing, Badger Self-equalizing Rings*— also in ALL-CURVE design — follow the contour of the corrugations and direct the distribution of stresses evenly among all the corrugations and also throughout each corrugation.

Excessive flexing or stress at any point is simply impossible. . . . Which means that when you install Badger Packless Corrugated Self-equalizing Expansion Joints in steam, gas, oil or other high-pressure lines, you have the most dependable, longest lasting expansion joints on earth!

*Exclusive in Badger Joints

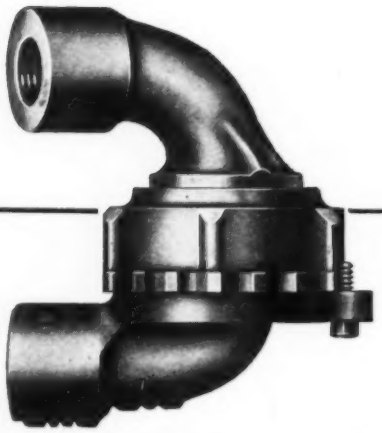
SEND FOR BULLETIN No. 100 giving further information about the highest quality product of its kind. Made in Copper for normal pressures and temperatures; in Stainless Steel for higher requirements — and where corrosion is a problem. Available in single or multiple corrugations — for traverses from a fraction of an inch upward. Also made in Non-equalizing type (without rings) for uses that do not require added protection.

E. B. BADGER & SONS CO. • 75 Pitts St., Boston 14, Mass.
AGENTS IN PRINCIPAL CITIES

Badger

PACKLESS CORRUGATED EXPANSION JOINTS

If it's Badger made it's got something



FLEXO JOINTS
—make pipe flexible

FLEXO JOINTS make pipe flexible with the safety of rigid fittings. They will swivel through 360°, yet there is no restriction of the flow of fluid. There is a full pipe area at any angle.

FLEXO JOINTS may be used for conveying steam, compressed air, water, oil, gas and other fluids under high or low pressure. Smooth working—no chattering or binding. Use them to make up movable pipe lines or to supply machinery or equipment with any fluid while in motion.

FLEXO

Write for Bulletin No. 166 and details on their use in your service.

FLEXO SUPPLY COMPANY, Inc.

4224 Olive Street *St. Louis 8, Mo.*

In Canada: S. A. Armstrong Ltd., 115 Dupont Str., Toronto 5, Ont.

EDCO
ROTARY
PUMPS

VANE TYPE
PATENTED CONSTRUCTION

At high or low speeds . . . whether creating a 28" vacuum or developing extremely high pressures . . . the vanes of EDCO Pumps maintain effective spanning position without springs or centrifugal action.

Fuel transfer pumps, coolant pumps and motor-driven assemblies. Furnished in capacities from 2 GPH up, in any required corrosion-resisting material. Operates silently at all speeds. Minimum maintenance required. Used for fuel oils and other fluids of any specific gravity.

FOR COMPLETE DATA . . . write today. Ask for Bulletin 936.

EDDINGTON METAL SPECIALTY CO.

P. O. Box K **Eddington, Pa.**

APPOINTMENTS

Yarnall-Waring Co transferred J Frank Long to Chicago district office as sales engineer. Charles H Grosjean is now in charge of Detroit sales office, replacing C N Maxfield, who has been appointed California district manager, with new sales offices in San Francisco and Los Angeles. Two new men have been added to *Yarway* sales staff: Jackson Kemper, New York office, and Jack Schuyler, Los Angeles office.

Charles H Jennings becomes engineering manager of welding dept, motor div, of **Westinghouse Electric Corp.** John H Blankenbuehler is made manager of arc-welding apparatus and E Hill Turnock Jr manager of arc-welding electrodes.

Westinghouse Electric Supply Co names Robert A Bozeman Southwest district stores manager, succeeding B C Luttrell, who resigned.

Robert M Hatfield has resigned as deputy vice chairman of the War Production Board to become assistant general sales manager of **Combustion Engineering Co.**

Allis-Chalmers Mfg Co appoints J L Singleton manager for the 60 district offices of general machinery div sales dept. C R Braun has been made supervisor of steam turbine dept marine sales. J K Keogh has become manager of Pittsburgh district office. G V Woody has been appointed manager of basic industries dept, succeeeding R C Newhouse who retired. Dr J T Rettaliata will continue his Allis-Chalmers association as consultant on gas-turbine development while serving as director of mechanical engineering dept at Illinois Institute of Technology.

Robins Conveyors Inc promoted Edwin M Perrin to assistant manager of equipment sales. He will work directly with A E Conover. Mr Perrin will prepare sales literature and special bulletins to industries using conveyors and other materials-handling machinery built by the company. Advertising copy is being prepared by Ross Roy, Inc.

Union Carbide and Carbon Corp announced election of following officers: Joseph G Davidson, vice-president, chemicals div; Stanley B Kirk, vice-president, industrial gases div; James W McLaughlin, vice-president, plastics div; William J Priestley, vice-president, alloys and metals div; John H Rodger, vice-president, railroad div; Arthur V Wilker, vice-president, carbon div; H Earl Thompson, vice-president, engineering; Robert J Hoffman, vice-president, industrial relations; Morse G Dial, secretary-treasurer.

Capt Vincent H Godfrey, who recently completed a tour of service in USN, has returned to Page Steel and Wire Div of **American Chain & Cable Co** as sales engineer, with headquarters at Monessen, Pa.

Appointment of Robert G Allen as general sales manager of **Baldwin Locomotive Works** has been announced. To give better service to users of SR-4 strain gage, Southwark div has placed field sales engineers in five of the company's branch offices: Richard

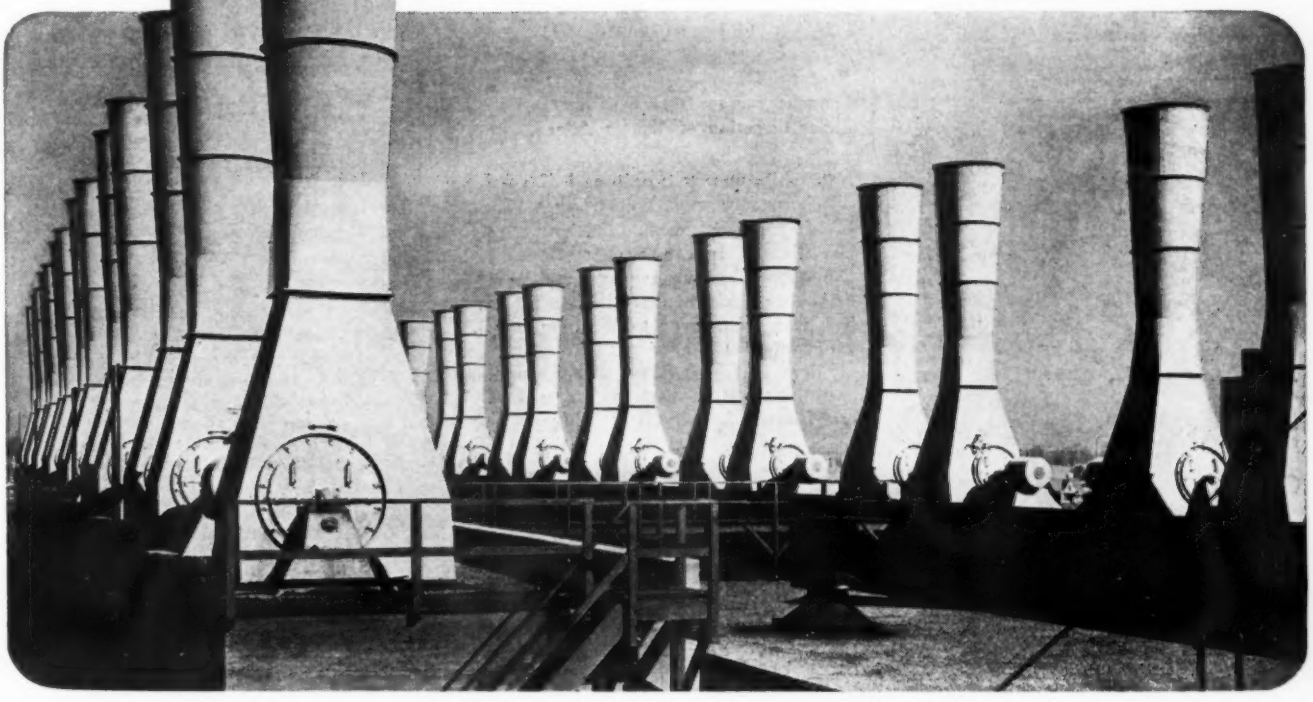
ELIMINATE *UNNECESSARY POWER PLANT DRAFT LOSSES*

LET THERMIX ENGINEERS PROVE HOW IT CAN BE DONE

Utmost power plant efficiency *demands* that fan, breeching and divergent stack be combined in a single compact unit in order to avoid resistances due to bends and sudden changes of section of duct work. This has been proved time and again by Thermix Fan Stack installations—in terms of hard cash savings in motor power consumption and in connection with almost any industry that might be mentioned.

Several years ago, for instance, the Schenley Distillers Corporation installed a single Thermix Stack by way of test. So great was the improvement that additional installations were quickly made!

Many similar cases prove beyond all question of doubt that power plants operating with old-style conventional draft equipment, consisting of a separate fan, breeching and stack, warrant an immediate investigation by Thermix field engineers and every new design of power plant should include this modern, economical method of draft production.



THERMIX ENGINEERING COMPANY

Project and Sales Engineers

First National Bank Bldg., Greenwich, Conn.

PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.

SCHERR TACHOMETER

Shipment NOW — Write for full details

With five speed ranges, will measure speeds to 48,000 rpm. Extreme accuracy — each dial individually calibrated for its instrument. Rubber terminal plug fits against shaft center. For measuring surface speeds on cutting tools, belts, etc., a 6" rubber edge wheel is used.

GEO. SCHERR CO., Inc.
196-A Lafayette St.
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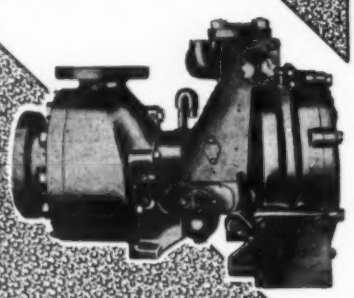
COFFIN TURBO PUMPS

FOR BOILER FEED AND GENERAL HIGH PRESSURE SERVICE



THE J. S. COFFIN, JR., CO.
ENGLEWOOD, NEW JERSEY

Hannon, Boston; Joseph Farley, Chicago; Robert Cleeland, New York; Glenn Rowell, Philadelphia; and Stanley Zansitis, Detroit. Jordan H Gaul is SR-4 sales manager at Eddystone, Pa., office.

Fairmont Coal Bureau, New York office, announces employment of Carl A. Marshall as fuel engineer.

Manning, Maxwell & Moore, Inc, announces following sales personnel changes; (1) Charles L Harris is appointed manager of distributor sales. (2) Newton P Selover succeeds Mr. Harris as manager of Midwestern district. (3) William F Loos has been made manager of Eastern district, with headquarters in the executive office of Chrysler Bldg., New York City. Under Mr Loos' supervision will also be the northern and southern New England territories as well as Mid-Atlantic district, which will extend the territories supervised by him. (4) William H Bolin becomes mgr of Mideastern district.

Manning, Maxwell & Moore, Inc, announces that their new plant for manufacture of Hancock products, which is being built at Watertown, Mass., will be ready for occupancy soon. When executive offices are completed at the new plant, the sales dept for these products will be moved from the Bridgeport, Conn., plant to Watertown, with M S Palmer as department manager.

Lynn Sawyer, general manager of pump div of **Byron Jackson Co,** was elected a vice-president of the company.

Rogers Diesel and Aircraft Corp announces reorganization of its service dept under direction of Walter Allard.

Navy ship, merchant ship and diesel-electric divisions, now a part of **General Electric Co's** federal and marine divisions, have been consolidated into a new marine division. E K Henley becomes manager and W H Wild manager of sales of that division. F C Ruling has been transferred to Washington, D. C., as assistant manager of GE's office there. William H C Lehman has been appointed assistant manager of apparatus sales of General Electric Supply Corp, Bridgeport, Conn.

Nordberg Manufacturing Co announces election of C G Cox as Pacific Coast manager of its heavy machinery div. He will make his headquarters in the San Francisco office. George Lienhard will continue in charge of service and installation there. Sales and service for the crusher div remains at its present location in Subway Terminal Building, Los Angeles, under the jurisdiction of T D Davis.

Appointment of C J Bickler as manager of sales of **Globe Steel Tubes Co's** Los Angeles office has been announced.

Seattle branch of **Fairbanks, Morse & Co** announced that Milwaukee Machinery Co, Portland, Ore., has been made exclusive distributor for complete line of turbine pumps. Their pump dept will be headed up by W H Perry. Cascade Machinery Co, Seattle, Wash., will handle all Fairbanks-Morse pumping equipment. Pump dept of

GOT SLUDGE TROUBLE?

NCC

Sludge Solvent

CLEANS AND KEEPS CLEAN
Dirty Tanks
Clogged Nozzles
Clogged Feed Lines
Dirty Strainers
Carbonized Pre-Heater Coils
Dirty Burner Tips

DOES NOT HARM METAL

NON-INFLAMMABLE

DOES NOT AFFECT THE FLASH POINT OF OIL

No matter how good your fuel oil is, it will create a sludge deposit.

Sludge follows oil like mud follows rain. But sludge is a serious nuisance, an expensive nuisance. Its harmful effects start in the tank whence it is distributed to the feed lines and burner and are felt right up into production —particularly where temperature control or atmosphere control are important.

Frequent shut-downs to clean sludge-fouled parts are only the beginning of sludge troubles. Neglected, sludge accumulates to the point where parts of the system must even be replaced.

Ridding yourself of sludge is easy and inexpensive. To your next load of fuel, just add NCC SLUDGE SOLVENT, the tested, scientifically prepared fuel oil conditioner. NCC dissipates water and other impurities. NCC liquefies sludge already formed.

Send trial order or write for bulletin, "Management Knows the Facts of Life."

NUTMEG CHEMICAL CO.
223 State St., New Haven 10, Conn.

They all REVOLVE

. . . the warmth-giving Sun . . . the life-producing Earth . . . the energizing Atom!

Like the sun, the earth, the atom, the Wing Unit Heater REVOLVES. It keeps the heated air in gentle motion, slowly circulating a constant, uniform, EVEN temperature, transforming hot and cold spots into comfortable, energizing, productive areas. The circulating heated air from the slowly revolving discharges reaches to farthermost corners, gets around and under obstructions, eliminates hot spots and cold spots.

Install Wing Revolving Unit Heaters now. Not only will they heat your plant comfortably and evenly, bringing a sensation of fresh, live, invigorating warmth to workers, but in the Summer, with the steam turned off and the fans on, they create a pleasant, cooling air motion over the entire area.

Write for Bulletin HR

L. J. Wing Mfg. Co. 154 W. 14th St. · New York 11, N. Y.

Factories: Newark, N. J. and Montreal, Canada

Wing

REVOLVING UNIT HEATERS

TURBINE BLOWERS · TURBINES · MOTOR DRIVEN BLOWERS · VENTILATING FANS · DUCT FANS · HEATING UNITS · SHIP VENTILATORS

ADAMANT
FIRE BRICK CEMENT

HOLD COSTS DOWN

by laying up furnace linings with Adamant . . . the fire brick cement of proved great bonding strength.* Adamant actually welds the brick together . . . protects the construction at the joints where failure usually begins.

Adamant has been proven STRONGER by test . . .

Impartial laboratory tests showed Adamant has a bonding strength of 800 lbs. at room temperature: 1270 lbs. at 2600° F. Adamant has a P. C. E. of 3000° F. plus. For more details, write

BOTFIELD
REFRACTORIES COMPANY

784 S. Swanson St., Philadelphia 47, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto

COMING IN 1946—

These informative, vital special sections, published every other month in POWER:

Feb.— Magnetic Drives

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Sept.—Gas Turbines.

Dec.— Boilers

To keep abreast of engineering developments as they happen, read:

POWER

A McGraw-Hill Publication
330 West 42nd St.
New York 18, N. Y.

Cascade will be managed by Clyde A Retter. This firm will also act as distributors for Fairbanks-Morse electrical equipment.

Kennedy-Van Saun Manufacturing & Engineering Corp appoints Edwin A Wert general manager of Southwest region, made up of Ariz., Calif., Colo., Utah and N. M.

Wickwire Spencer Steel Div, Colorado Fuel & Iron Corp, made Herbert D Rollo sales manager for New England District.

Bacharach Industrial Instrument Co, Pittsburgh, purchased the Practical Instrument Co of Chicago. Portable temperature, humidity and operation recorders formerly made by Practical Instrument Co will now be manufactured in the Bacharach plant. Production equipment and other physical property of the purchased company is being transferred from Chicago to Pittsburgh.

Swartwout Co established a new Chicago office to serve steam power-plant equipment customers. H P DeHart is in charge of this office at 120 S La Salle St, Chicago. Swartwout ventilator sales in Chicago area continue under L V Warner at 549 Randolph St.

Briggs Filtration Co acquires Briggs Clarifier Co. Officers of the new company, all of whom served with the old company, are Chase Donaldson, president; S W Briggs, vice-president; R C Zschiegner, treasurer; W. E. Furey, secretary-counsel; Cecil Hopkins, assistant secretary. Directors are Chase Donaldson, president; S W Briggs, vice-president; Richard P Dunn, partner, Auchincloss, Parker & Redpath; Bradley J Gaylord, vice-president, Pennroad Corp, Wilmington, Del; Clark W McKnight, Wilmington, Del.

Weston Electrical Instrument Corp appoints Harold L Olesen as general sales manager. H L Gerstenberger, who formerly served in that capacity, continues as vice-president in charge of sales.

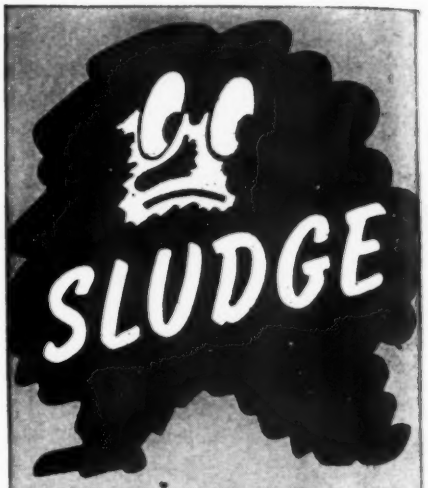
Howard M Cutshaw has been made assistant sales manager and Thomas A Marsh manager of corporation sales of **Iron Fireman Manufacturing Co.** Mr. Marsh succeeds Karl Saboe, who recently transferred to St. Louis as branch manager.

Announcement was made recently of election of Fred A Jackle, works manager of Chase metal works and Chase rolling mill plants, as a vice-president of **Chase Brass & Copper Co.** He will act as a special consultant on the staff of Richard D Ely, vice-president in charge of production. Walter L Smith has been promoted to works manager of metal works and rolling mill plants in Waterbury.

Fisher Governor Co announces appointment of Puffer-Sweiven Co as its exclusive representative in Texas Gulf Coast area.

Cutler-Hammer Inc announces the election of E U Lassen as assistant chief engineer.

Eshelman & Potter appointed G S Myers a member of the chemical engineering staff. As service engineer, Mr. Myers' work will involve both Hagan combustion control and Hall Laboratories water conditioning in Southern areas, including the marine field.



IS THE LAZY PART IN OIL . . . SAVE IT

Saverite

SLUDGE SOLVENT *will make it work for you*

When you buy oil — even the finest oil — you buy a certain percentage of sludge. Unless fuel oil is treated, it settles out in storage tanks — impeding the flow of the oil. This condition need not be tolerated. Saverite Sludge Solvent will turn this sludge into power by holding it in suspension in the main body of the oil, making it combustible. With Saverite application, tanks and coils remain clean, carbonization of burner tips is avoided, better atomization is assured, and maximum heat value obtained. Smoke hazard is lessened, fuel lines conserved, money saved. Start using effective, inexpensive Saverite Sludge Solvent now.

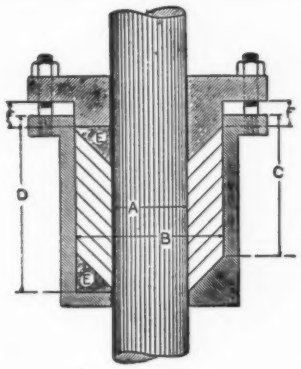
For further information, use the convenient coupon, and write to

Saverite
ENGINEERING COMPANY

1030 Willow Avenue, Hoboken, N. J. — 5800 So. Hoover Street, Los Angeles 44, Calif.

SAVERITE ENGINEERING COMPANY
1030 Willow Avenue
Hoboken, N. J.
Please send me your folder on "Saverite Sludge Solvent."

NAME _____
ADDRESS _____
CITY _____ STATE _____



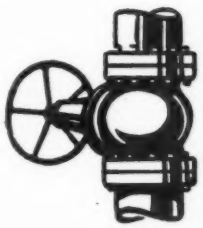
Q-P Self-Setting PACKING

PERFORMANCE-PROVED UNDER UNUSUAL OPERATING CONDITIONS . . . . . .

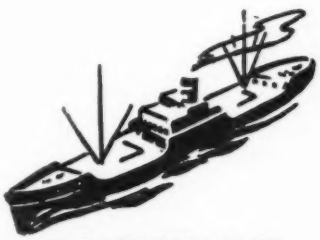
Q-P Self-Setting Packing has demonstrated its superiority under the most difficult conditions on land and sea and can be depended on to meet post war requirements for high maintenance economy. It is the ideal packing for superheated steam, saturated steam, hot and cold water, ammonia, fuel oil, compressed air, gases and acids and other operating conditions.

Q-P Self-Setting Packing is moulded to the exact diameter of the rod and stuffing box from various materials depending on the conditions involved. The smaller diameter of the ring or cone, always points toward the condition being sealed. Under pressure the lips of the packing are closed automatically against the rod and the side of the stuffing box with minimum friction, assuring a perfect seal without causing excessive friction or undue wear of rod or packing. Removal of pressure frees the packing from the rod.

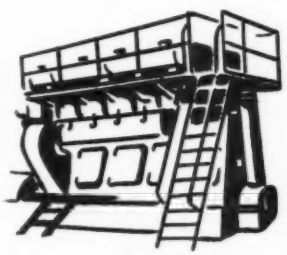
Q-P Self-Setting Packing is made in solid and split types to specified rod and stuffing box dimensions. Its proper installation assures longer packing life, infrequent tightening up of gland, and elimination of rod scoring. Outstanding savings in maintenance are a matter of record wherever *Q-P Self-Setting Packings* have been used.



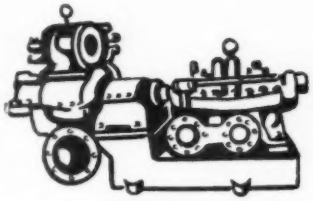
VALVES



TELEMOTORS-VALVE

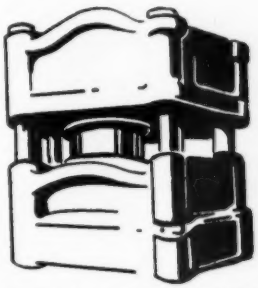


DIESELS



TURBINES

EXPANSION JOINTS



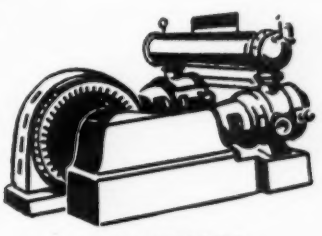
HYDRAULIC EQUIPMENT

WRITE TO US AND OUTLINE THE SERVICE TO BE PACKED AND WE WILL SUPPLY THE PROPER PACKING

Sales Representatives

Belmont Supply Co., Waltham 54, Mass.
Chapman Industrial Supply Co., Los Angeles 13, Calif.
Darling Bros., Ltd., Montreal, Canada.
A. G. Day, South Braintree, 85, Mass.
Hercules Eqpt. & Rubber Co.—San Francisco, Calif.
Industrial Equipment Co., Charleston 23, West Va.
Kellogg Appliance Co., Philadelphia 44, Pa.
Kindred Appliance Co., Inc., New York 7, N. Y.
Marine & Industrial Supply Co., Seattle 4, Wash.
Meyer Ekstrom Co., Chicago 6, Ill.
Ellis W. Morse Co., Binghamton, N. Y.
Harry A. Neff, Fort Wayne 3, Ind.
Paramount Packing Co., Baltimore, Md.
Rex F. Rorabacher — Grand Rapids 7, Mich.
John W. Ruhrstorfer—Detroit 8, Mich.
Elliott M. Sergeant—Niagara Falls, N. Y.
Peter J. Soulen—Milwaukee, Wis.
The Stephan Company—Cleveland 3, Ohio
Tutein Equipment Company—Pittsburgh 5, Pa.
Uhrich Supply Co., No. Kansas City 16, Missouri

The
Q-P MANUFACTURING COMPANY
NEEDHAM HEIGHTS, MASS.



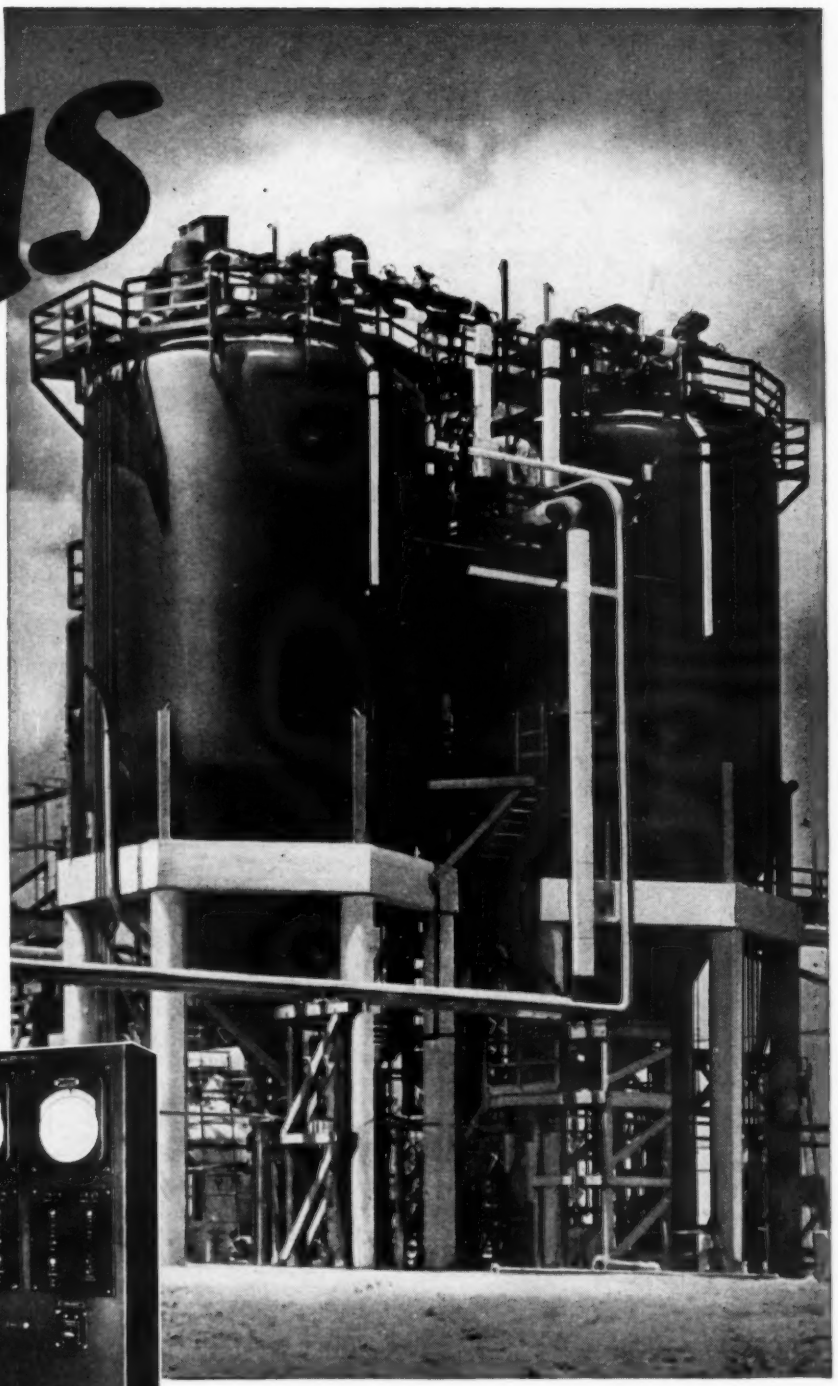
COMPRESSOR
(AMMONIA)

2 sets of TWINS

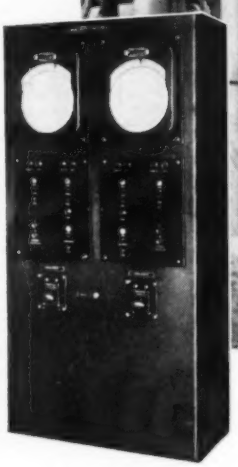
. each with a capacity of

50,000 Gals. per Hr.

An interesting installation of Cochrane Deaerating Hot Process Softeners is that of a Southern oil company, which has erected two double-unit softeners, with a total capacity of 200,000 GPH. River water, already treated with coagulant and dolomitic lime in a preclarifying system, is introduced into the Softeners, which have 60° sludge cones. Reagents used are lime and soda ash. One installation uses Cochrane electrically operated proportioners to control individual chemicals; the other installation uses dry feeders. The battery of nine 10-ft. filters have individual valve nests so that they can be back-washed in the conventional way or with filtered water.



Above are shown the sedimentation tanks of one of the twin units. Note 60° sludge cones.



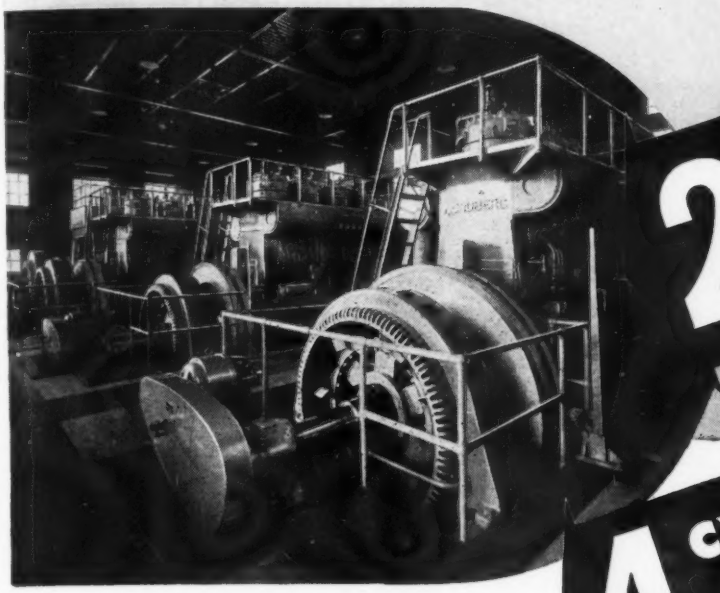
Panel Board with Flow Meter Control of Chemical Feed

COCHRANE CORPORATION 3106 N. 17th ST., PHILADELPHIA 32, PA.

COCHRANE

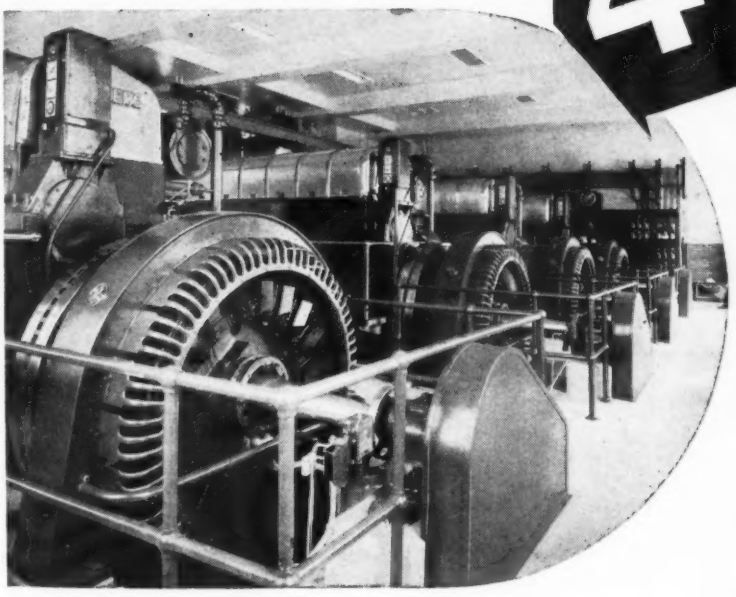
SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES

A NORDBERG DIESEL
will supply your power needs



2 CYCLE ENGINES
Available in sizes up to 8500 B. H. P. in a single unit.

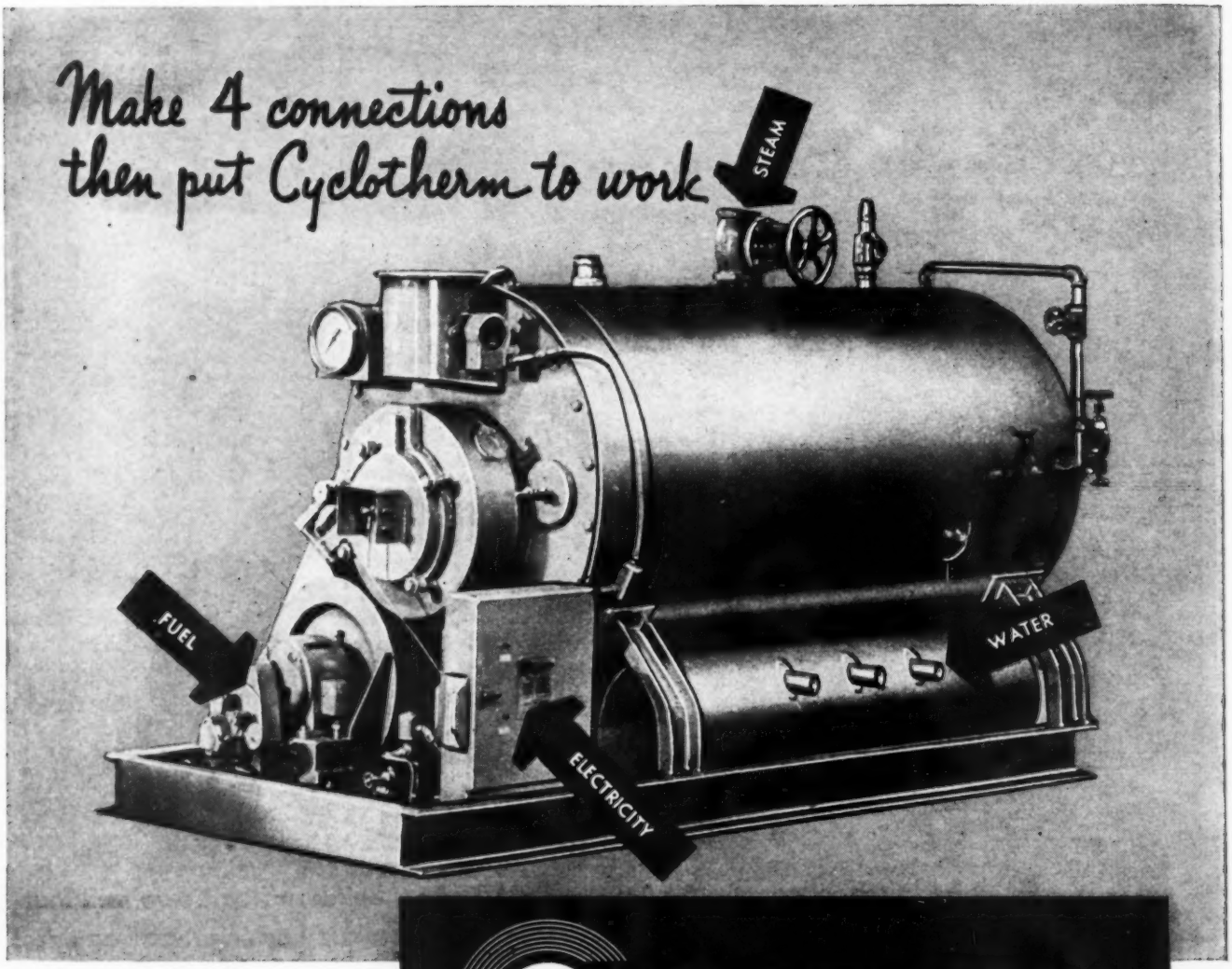
4 CYCLE ENGINES
Built in non-supercharged and supercharged designs in sizes up to 1600 B. H. P.



As a builder of both two and four-cycle oil or gas burning Diesel engines, Nordberg can supply the power needs of plants small and large and a type engine best suited to each requirement. Back of these engines is a record of many years of successful performance that has won for Nordberg a position of leadership in the Diesel power field. The many repeat orders from satisfied users attests to this fact. For dependable, low cost power, investigate the merits of Nordberg Diesels. Our engineers will gladly furnish further particulars on an engine to meet your power demands.

NORDBERG MFG. CO., Milwaukee 7, Wis.

NORDBERG
DIESEL ENGINES



30 HP Cyclotherm Oil-Fired Unit

CYCLOTHERM
STEAM GENERATOR

Your Cyclotherm Is Ready

Order your new post-war Cyclotherm now.

Cyclotherm is available *without* priority for fast delivery. Once your order is received action is immediate.

Your Cyclotherm comes to you a completely assembled, packaged unit. It needs no special foundation, or base; no stack. Installation consists only of connecting steam, water, fuel and electric lines. Your Cyclotherm can be producing steam in a matter of hours after delivery to you.

Cyclotherm units range from 5 HP to 200 HP with operating pressures from 15 psi to 200 psi. They are completely self-contained, automatic, oil or gas fired. They are designed on unique principles of combustion that give top efficiency while holding operating and maintenance costs to a minimum.

Thousands of Cyclotherm units were in war service throughout the world with the Army, Navy and Marine Corps. Their record of accomplishment is your best guarantee of the engineering "know-how" back of a Cyclotherm, and the quality built into every unit.

What the Veteran Cyclotherm did in the four corners of the world, the post-war Cyclotherm will do for you, whatever your use of steam may be.

Your order for a Cyclotherm will be filled promptly.

CYCLOTHERM CORPORATION · Box 202 · 90 Broad Street, New York 4, N. Y.

INTRODUCING

ANCHOR Nº 913 ACCORDION PLEATED HIGH PRESSURE PACKING ... *NOW IN PRODUCTION*

Fabricated from high grade woven asbestos cloth, impregnated with heat resisting binder • • Recommended for use on troublesome steam, air or hot high pressure rods, valve stems, expansion joints, etc. If you have experienced difficulty with regular types of high pressure packings, try this packing and watch its performance • • Recommended also for use on pistons.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

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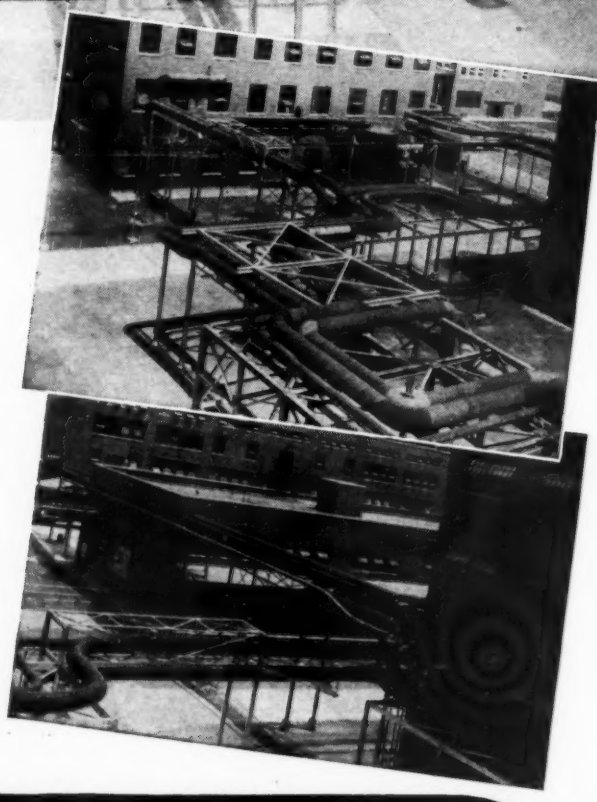
Boston 14, Massachusetts	303-04 North Station Building	Milwaukee 2, Wisconsin	903 East Kilbourn Avenue
	150 Causeway Street	New Orleans 4, Louisiana	418 Common Street
Buffalo 2, New York	Andrews Building	New York 13, New York	100 Sixth Avenue, near Canal
Cleveland 13, Ohio	523-25-27 Rockefeller Building	Philadelphia 8, Pennsylvania	401 North Broad Street
Columbus 9, Ohio	172 North Cassingham Road	Pittsburgh 22, Pennsylvania	405 Penn Avenue
Chicago 11, Illinois	230 East Ohio Street	Portland 1, Oregon	1433 S W Front Avenue
Cincinnati 2, Ohio	4 West 7th Street	San Francisco 7, California	156 South Park
Detroit 26, Michigan	169 West Jefferson Avenue	Seattle 4, Washington	2207 First Avenue, South
Houston 2, Texas	509 Washington Avenue	St. Louis 3, Missouri	1407 Pine Street
Kansas City 6, Missouri	1332 Oak Street	Tulsa 4, Oklahoma	823 South Gary Place
Los Angeles 21, California	720 Mateo Street	Wilmington, California	524 North Avalon Boulevard

SKILLED ENGINEERING

The difficulties encountered in the fabrication and erection of Central Station and Industrial Piping are many and varied.

The high degree of skill acquired by Navco Engineers from long experience in solving unusual Piping problems is your assurance of economy and safety of operation.

Consult Navco for your next Piping Job.



NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO

MORE AIR IN 12 HOURS!

Worthington "Huskies" Quickly, Easily Installed by United States Hoffman Machinery Corporation

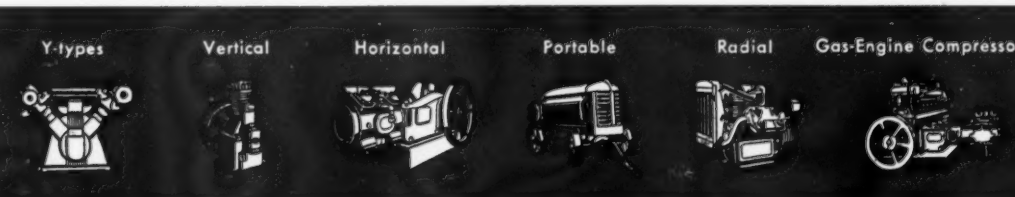
September 12, 1944
Mr. W. A. Meiter, Buffalo District Manager
Worthington Pump and Machinery Corporation
37 Church Street
Buffalo 2, New York
Dear Sir:
You will be interested to know that the third unit of our six 150 HP YC-2 compressors was placed on foundation, piped, and turning over, twelve hours after it was delivered in our plant.
This demonstrates convincingly that this type of compressor saves considerable installation time when compared with a horizontal duplex type unit.
Congratulations for having a real "packaged" large air compressor.
Yours very truly,
UNITED STATES HOFFMAN MACHINERY CORPORATION
Henry C. A. Meyer
Assistant to the President
HCAMiss

GET ALL THE FACTS ON MODERN YC AIR COMPRESSOR DESIGN

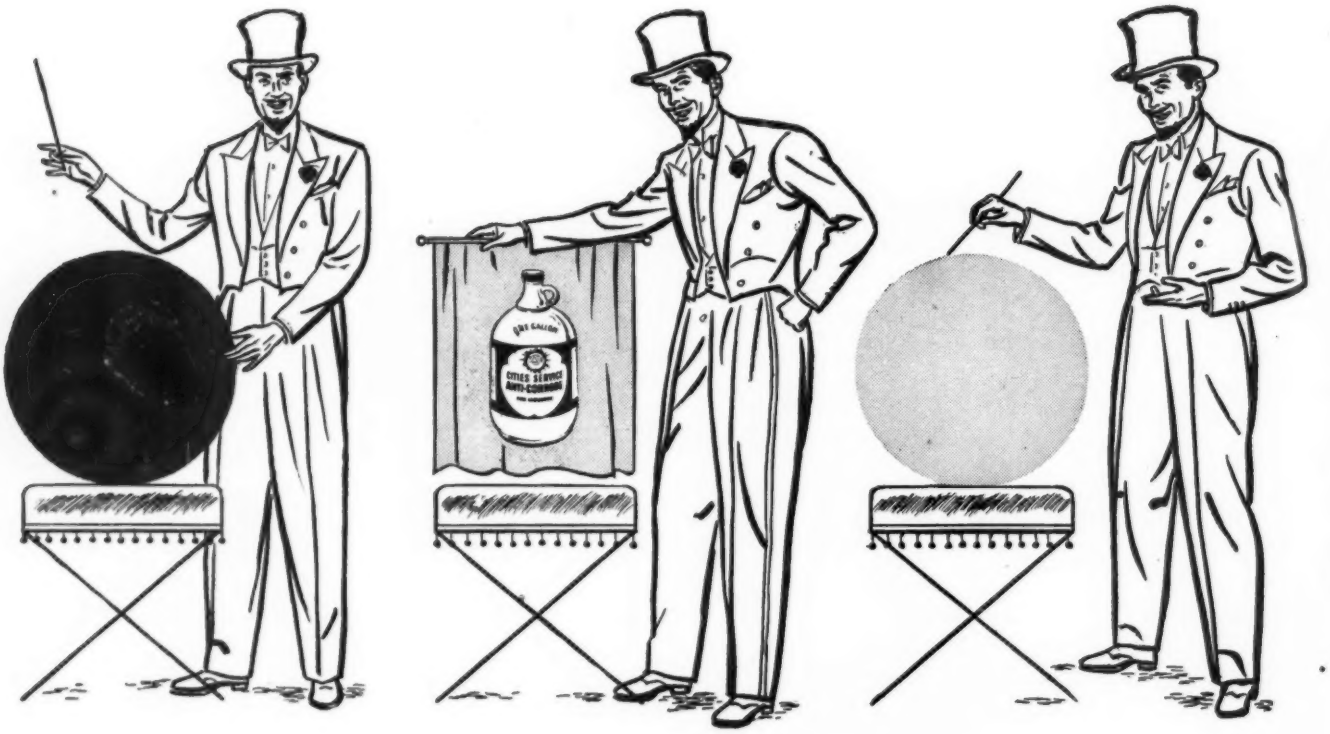
Write to Publications Dept., Harrison, N.J., for Bulletin L-667-B1 — complete facts on higher speeds, ease of installation, accessibility of the Worthington YC "Huskie" Air Compressors that helped United States Hoffman Machinery Corporation rush the manufacture of shells. Adaptable... direct-connected, or easily arranged for belt drive on practically any type of rotative power. Another reason why *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Compressor Div., Buffalo, N.Y.*

WORTHINGTON

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



Now you see it_Now you don't



What you see is a close-up of rust formation, Industry's $100,000,000 annual toll. What you *don't* see is its quick elimination with CITIES SERVICE RUST REMOVER.

Converting your rust liability into profit isn't magic . . . it's made possible by Cities Service Rust Remover—an effective product—proved in scores of industrial plants. Easy to apply—inexpensive—can be used over and over again with little waste.

Once you have cleared your machined parts of rust, the next step is to protect them against further rusting. Then you will want one of the Cities Service Anti-Corrodes to provide an impenetrable film that really protects. One of our Lubrication Engineers will be glad to help you select the right one. Write, wire or phone our nearest office or . . .

Cities Service Oil Co.
Room 585, 70 Pine Street, New York 5, N. Y.

Gentlemen: Please send me full information on Cities Service Rust Prevention Plan.

Name.....

Title.....

Company.....

Address.....

City.....State.....

MAIL THIS COUPON TODAY

CITIES SERVICE OILS
ONCE-ALWAYS

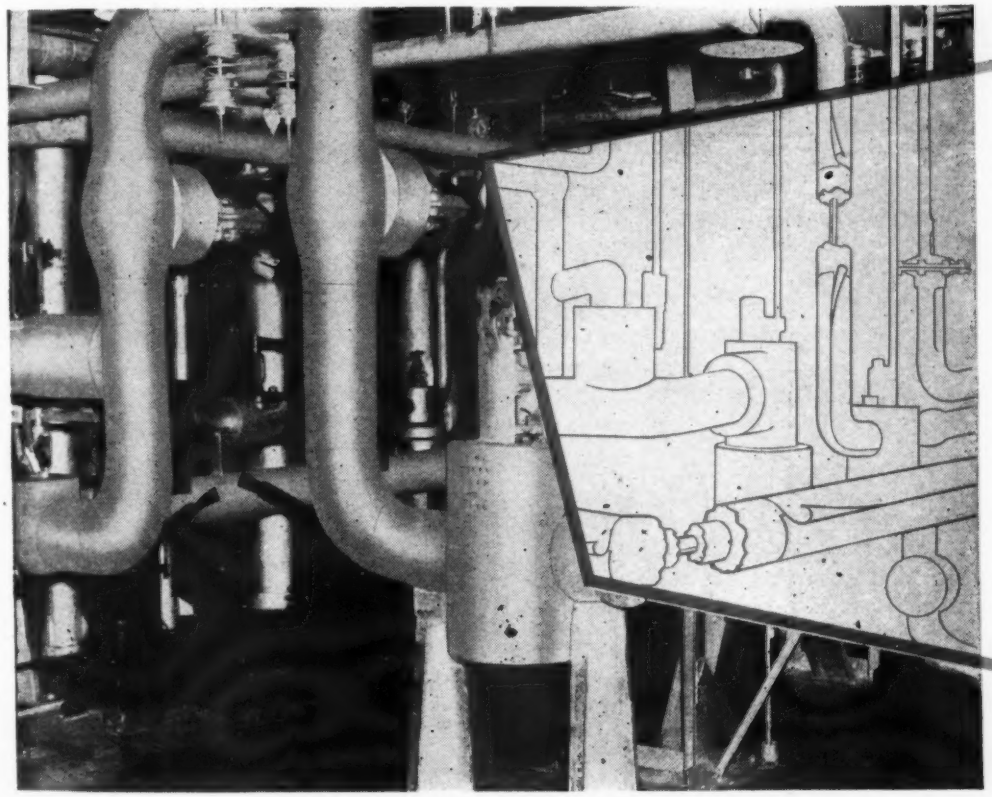
Why you get a better heat insulation job when you use this triple service

1. MATERIALS. **Insulations of tested efficiency—a complete range covering every temperature and condition—are used on your job by Armstrong's Contract Service.**

2. ENGINEERING. **Armstrong's experienced engineering staff is ready at all times to cooperate with you in writing specifications to meet every possible requirement, however unusual it may be.**

3. WORKMANSHIP. **Crews of trained Armstrong craftsmen, located in major industrial centers, apply your insulation in accordance with the best standards and practices and in accordance with a rigid code of workmanship.**

IT takes all three of the essentials—materials, engineering, and workmanship—all of them supervised with exacting care by men who know every phase of the business, to give you a better heat insulation job. Because Armstrong's Contract Service combines all of these functions in one responsible organization, it gives you assurance of superior performance. And, as added assurance that all three of these essentials are rightly used on your job, the full resources of the Armstrong Cork Company back up every job done by its Contract Service. For complete information, write today to Armstrong Cork Company, Building Materials Division, 7001 Concord Street, Lancaster, Pennsylvania.



This cutaway view shows how Armstrong insulated the high-pressure steam lines at a pressure-reducing station in a large Eastern power plant. Lines were covered as follows:

Pipe Size	Thickness of Insulation: High-Temperature	Thickness of Insulation: 85% Magnesia
1"	2"	....
2" and 3"	1½"	1½"
4" and up	2"	1½"

Sewed canvas jackets were used on all these lines.

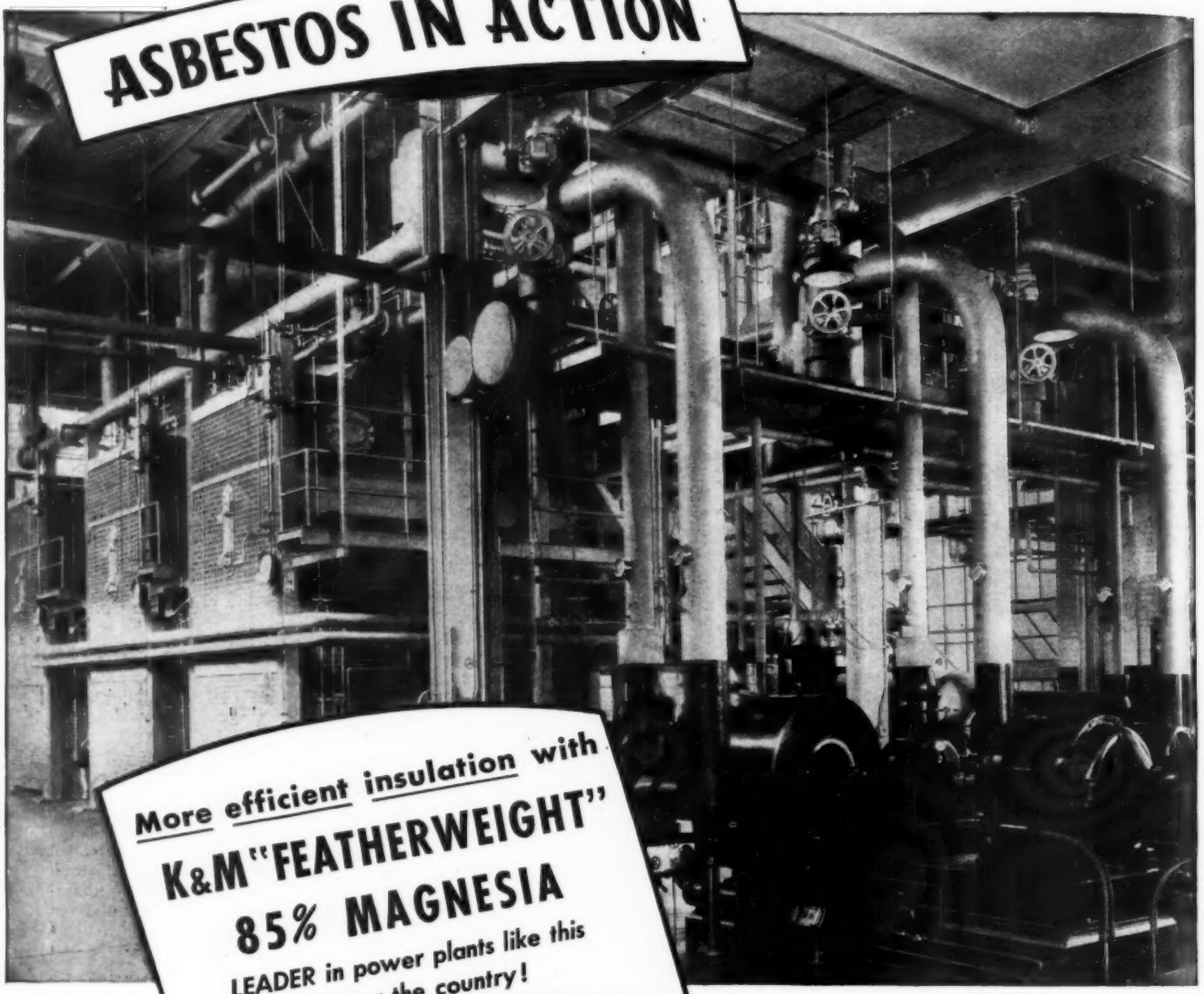
ARMSTRONG'S INDUSTRIAL INSULATION

Complete Contract Service For All Temperatures

From 300° below Zero

To 2600° Fahrenheit

ASBESTOS IN ACTION



...AND HERE'S WHY!

Carbonate of magnesia is an *exceptional* insulating material because of the great number of microscopic dead air cells it contains. Asbestos fibre is added for structural strength. In the manufacture of K&M "FEATHERWEIGHT" the quality and percentage of carbonate of magnesia used is carefully controlled . . . hence its high efficiency and wide acceptance by industry.

Remember, "FEATHERWEIGHT" offers:

- **Lasting effectiveness**
- **Durability**
- **Dependability**

Besides being a fuel-saver, K&M "FEATHERWEIGHT" 85% MAGNESIA is maintenance-free. Engineers recognize its superiority over all other insulations because it is free from any danger of disintegration or material chemical change at average temperatures up to 600° F.

Nature made Asbestos . . . Keasbey & Mattison has been making it serve mankind since 1873, while K&M "Featherweight" has been known as a symbol of *quality* for 59 years!

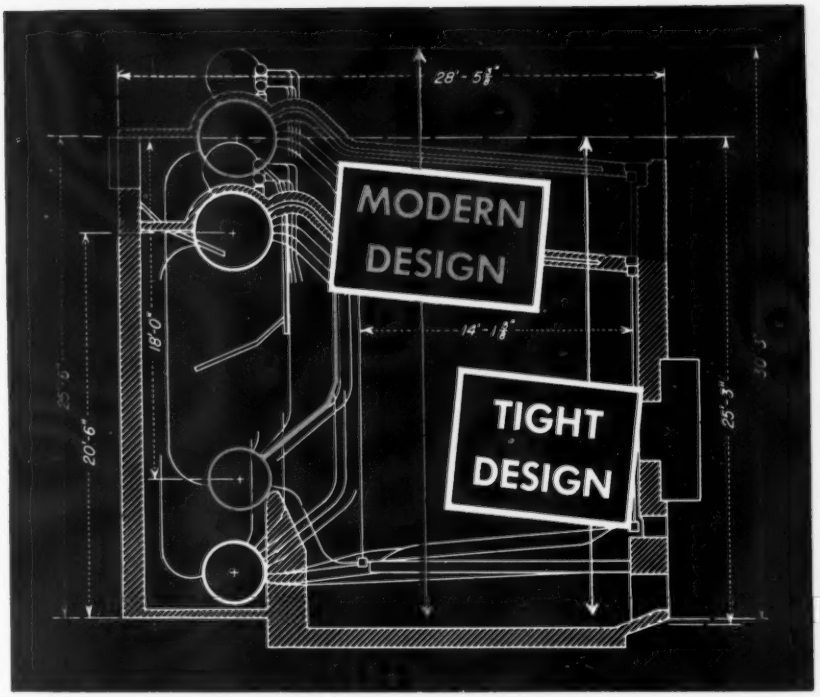
KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

K&M best in asbestos

Defining "FLEXIBILITY"

TIGHT DESIGN–restricted fuels
MODERN DESIGN–fuel flexibility

DESIGN SPECIFICATION The Design Specification should give the critical characteristics of typical fuels which will be economically available during the life of a new Power Plant. A leading equipment manufacturer selects Ash Softening Temperature as a controlling factor, and says, *"The basis of modern boiler and furnace design is to so proportion the furnace and cooling surface in the furnace that under average conditions of furnace wall cleanliness, the temperature of the gas entering the boiler surface will be below the ash fusion temperature."*



RANGE IN QUALITY The Fuel Investigation develops the range in fuel quality which should be planned for. This manufacturer shows here a "tight design" requiring the use of restricted fuels, and outside of this he shows a "modern design" with a larger furnace so proportioned that a wide range of fuels can be used.

FLEXIBILITY Sound planning requires that new or modernized power plants provide sufficient latitude to permit the utilization of the range of coals competitively available during their useful life. In so doing, Utilization Flexibility is achieved.

FAIRMONT COAL The Fuel Investigation reveals that Fairmont Coal will probably be an excellent value in many markets for many, many years. Utilities and Industrials are using Fairmont Quality as the design basis for new power plants.

Designing for Fairmont Coal permits the use of a wide range of fuels. Initial investment for flexibility is somewhat higher, but the additional cost can be quickly amortized and permanent savings are possible through the use of the best fuel value available.

MAIL COUPON TODAY

FAIRMONT COAL BUREAU, Chanin Bldg., 122 E. 42nd St., New York 17, N. Y.

Write for Reference Bulletin No. 5 for the details on investment required for flexibility in plants requiring 400,000#, 200,000#, or 60,000# of steam per hour. Your request will automatically put your name on our mailing list. P-146

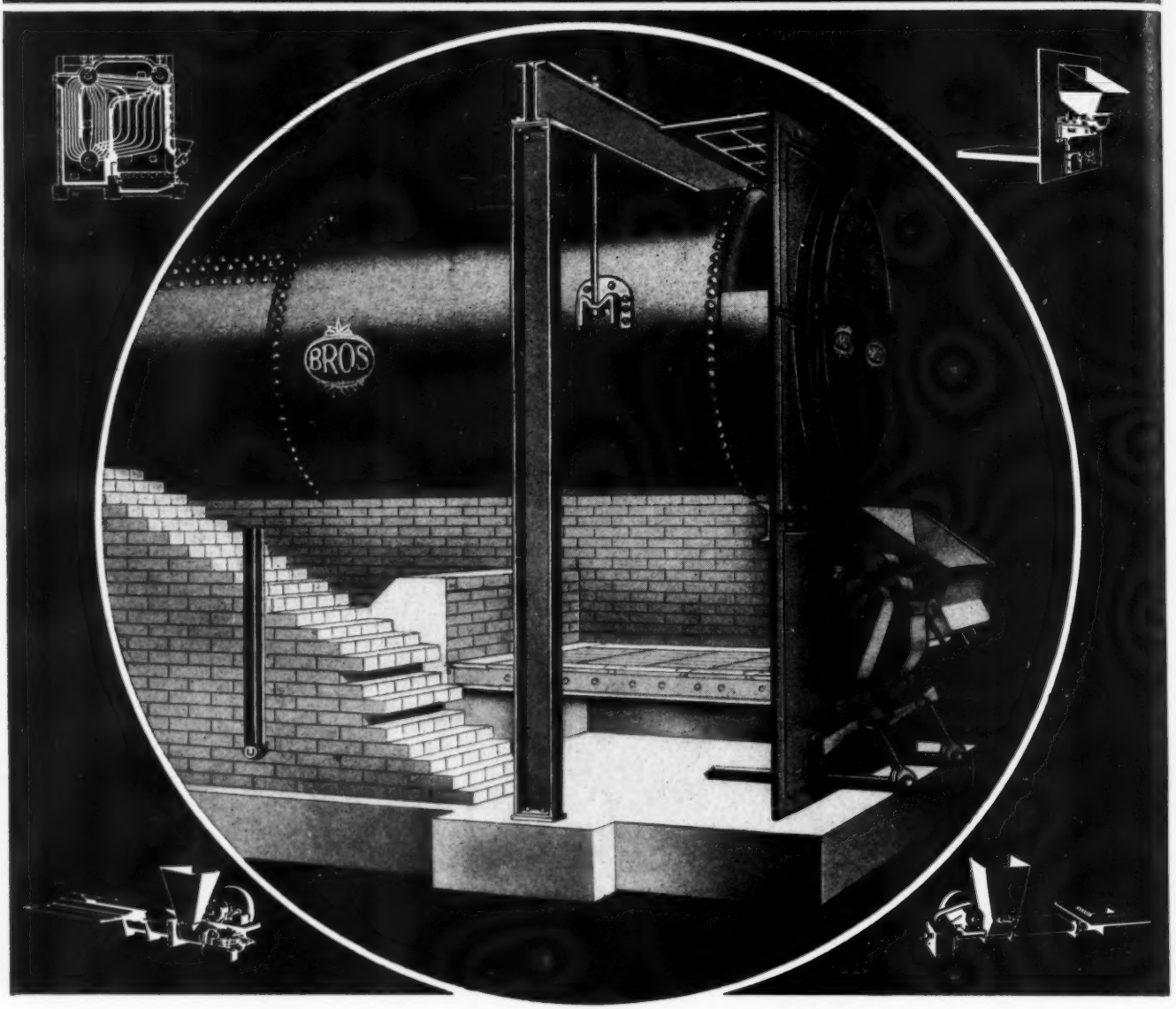
NAME .....

COMPANY .....

POSITION .....

STREET ADDRESS ..... CITY ..... ZONE ..... STATE .....

STEAM IN VAST QUANTITIES



...with BROS H.R.T. BOILERS

WHEN steam is needed in greater quantities than normal boiler operations produce, one sure way of meeting the unusual requirements is to install a Bros H.R.T. Boiler, equipped with Model 24 Super-Spred Stokers.

This type of steam generating equipment produces the desired high pressure steam over a period of many years without decrease in efficiency. It offers a steam capacity up to 175% of rating—a profitable margin to have for emergency use or for plant expansion. Its operating and maintenance costs are low. Write today for complete information on Bros H.R.T. Boilers and Super-Spred Stokers. Wm. Bros Boiler & Manufacturing Company, 1057 10th Avenue S. E., Minneapolis 14, Minnesota.

BROS

FABRICATORS OF STEEL • BOILERS • STOKERS • TANKS • ROAD EQUIPMENT

Lugging coal—you've done it, perhaps, in a small way. In a big way, it's a back-breaking job. But not for this conveyor belt of ours, in a Pennsylvania coal mine; despite reverse bending, a right-angle feed, large and unequal pieces to be carried, and an uneven distribution of load.

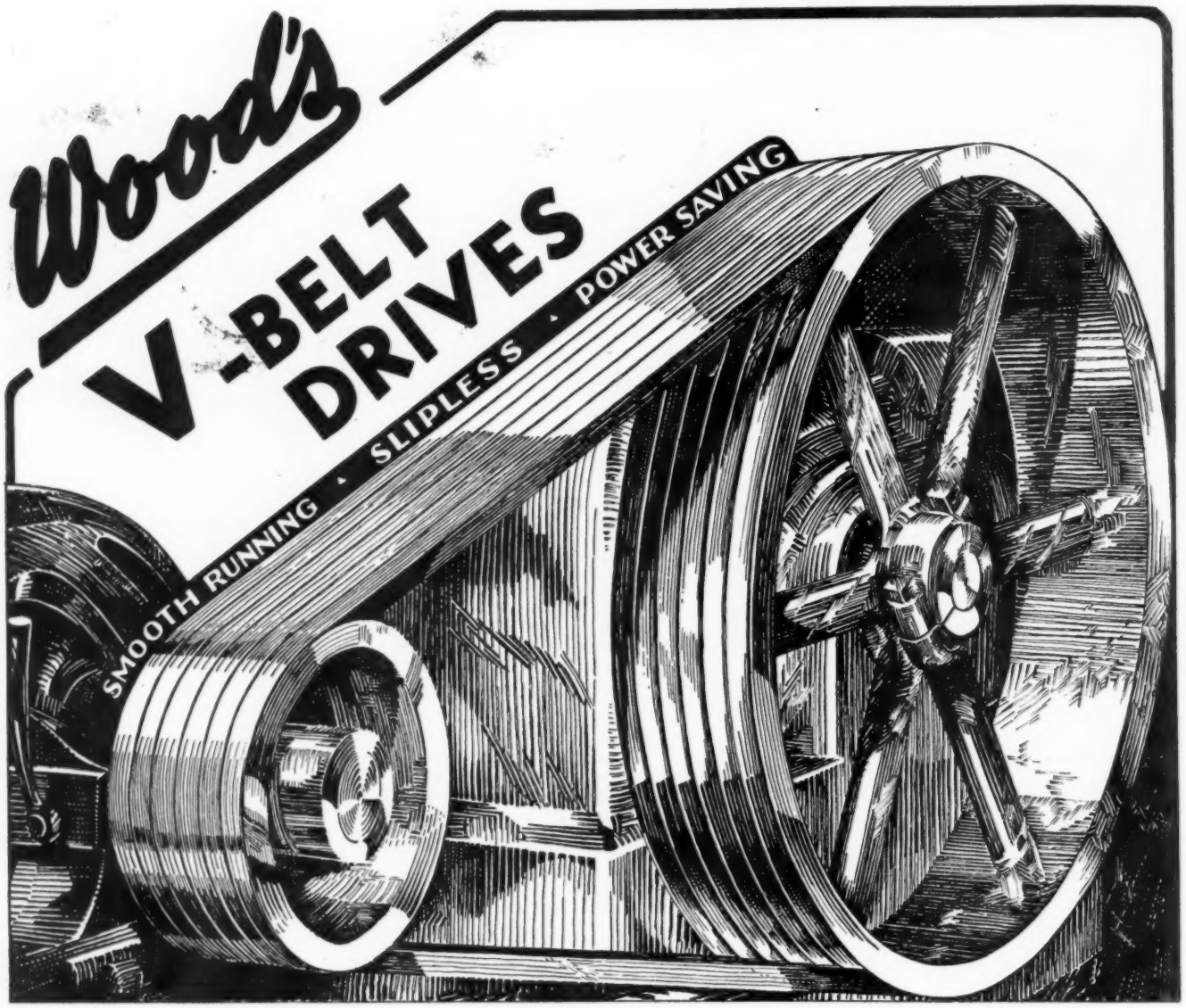
All these difficulties have meant nothing to it. It has been operating for many years, and plans to be for many more. BWH quality in materials, and our exclusive Rotocure process of vulcanization, are the answer.

Something rough and tough to carry? Ask our nearest distributor, or write to us. You'll be convinced.

BOSTON WOVEN HOSE & RUBBER COMPANY
WORKS: CAMBRIDGE, MASS.
POSTAL ADDRESS: BOX 1071
BOSTON 3, MASS., U.S.A.

KEEP THOSE BONDS

Made by the Rotocure process of continuous vulcanization which replaces variation with uniformity.



Precision design and construction characterize this ideal power transmission unit. Soundly engineered, fabricated from superior materials, the silent, dependable Wood's V-Belt drive is an economical investment because—

1 Wood's precision V-groove sheaves have perfectly designed grooves, accurately machined to gauges for width, depth and angle. They are uniformly spaced and conform to standards set in the industry. Wood's are the oldest builders of cast iron pulleys. The proportions of rim, hubs and arms developed through years of experience in the design and manufacture of pulleys, have helped Wood's to produce the best type of V-groove sheave.

2 Wood's V-Belts are full molded, resilient and flexible . . . extremely accurate in design. The fact that horsepower requirements utilize only a small percentage of the ultimate strength of these belts—ruggedly constructed of the strongest materials—accounts for their extremely long life.

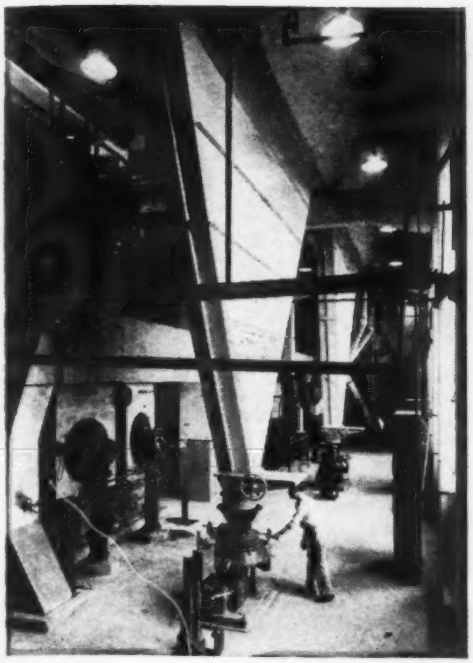
3 Wood's V-Belts and sheaves are *engineered to work together.* Since the proper groove contour of the sheave permits complete belt contact and uniform seating of the "tailor made" V-Belts, Wood's V-Belt drives transmit energy from its source to the driven machinery with maximum efficiency. Engineering consultation welcomed . . . or see your conveniently located Wood's dealer.

EVERYTHING IN TRANSMISSION

Pulleys — Clutches — Hangers — Pillow Blocks
Couplings — Bearings — V-Belt Sheaves
and Complete Drives

T. B. WOOD'S SONS COMPANY, CHAMBERSBURG, PENNA.

BRANCHES: BOSTON, MASS. NEWARK, N. J. PITTSBURGH, PA. CLEVELAND, OHIO DETROIT, MICH. HOUSTON, TEXAS

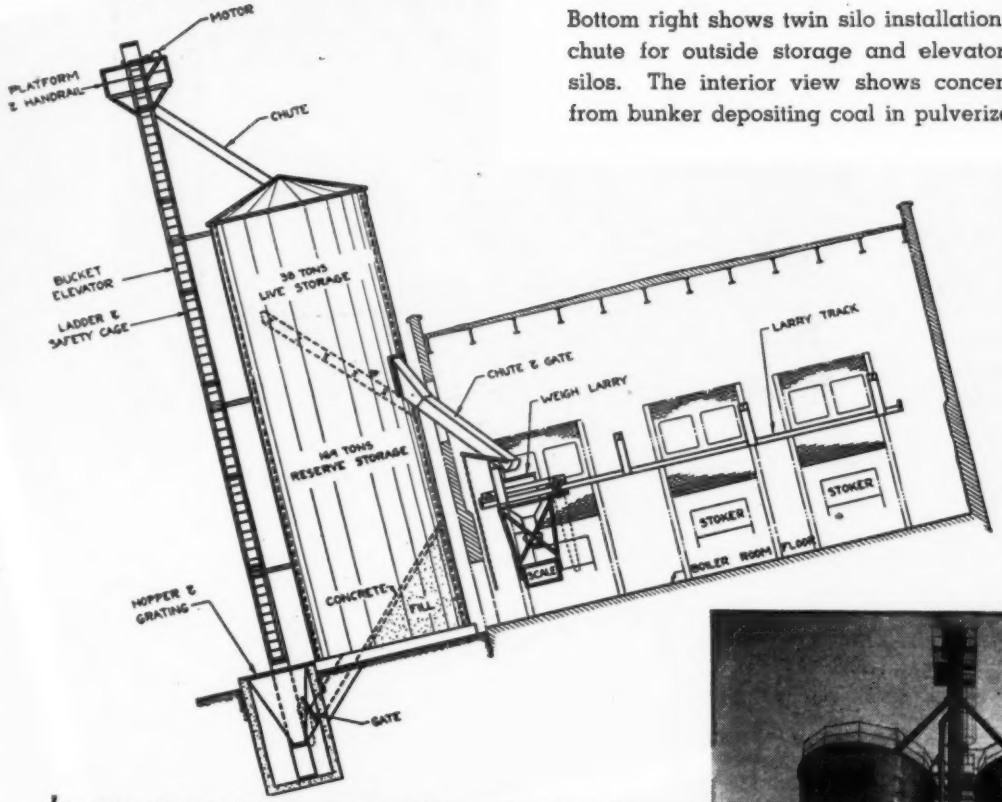


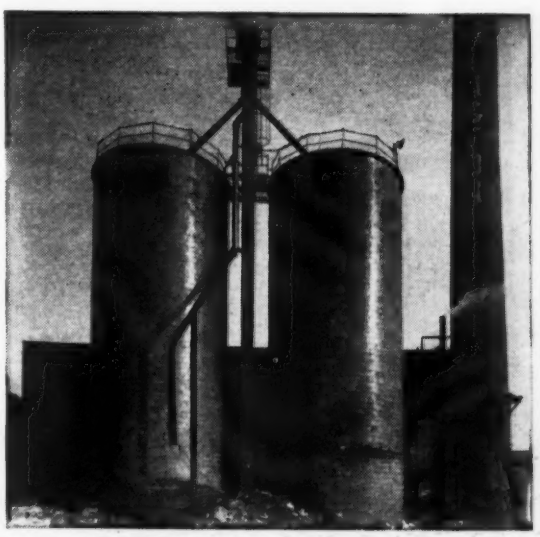
FAIRFIELD
Coal and Ash Handling
SYSTEMS

The engineering of coal and ash handling equipment by Fairfield to meet the specific operating needs of your plant assures maximum efficiency and minimum costs.

For example, for storage and handling of coal Fairfield will build an outside silo of vitrified tile or an inside steel bunker depending upon your requirements. The coal is handled automatically from car to storage to stoker or pulverizer. Your boiler room is clean and free from coal dust. Your coal is fed to the boilers to give peak efficiency.

Bottom right shows twin silo installation with overflow chute for outside storage and elevator feeding both silos. The interior view shows concentration chutes from bunker depositing coal in pulverizers.





Fairfield designs—builds—erects complete coal and ash handling systems. You have but one responsibility for the entire installation. There's a Fairfield representative near you. Consult him on your coal and ash handling system—for reconversion—for extension—for new plant. *Bulletin* on request.

THE FAIRFIELD ENGINEERING CO.

Builders of Coal and Ash Handling Equipment

320 CHICAGO AVENUE • • • MARION, OHIO

AUTOMATIC CONTROL EQUIPMENT

ENGINEERED DESIGN BY

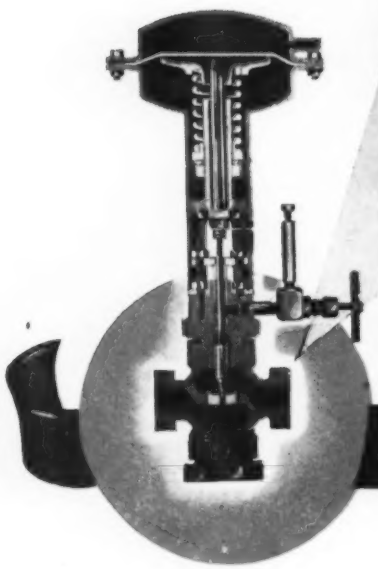
HAMMEL-DAHL

Extremes in Automatic Flow Control

10,000 GPM

DIAPHRAGM OPERATED BUTTERFLY VALVES

- Sizes to 30" on application.
- Rugged Duri-Steel Superstructure and operating mechanism
- Handwheel for manual operation
- Full capacity bodies with maximum throttling action
- Designed for maximum in frictionless operation
- Large area radiation fins for transfer of flowing fluids temperature from standard bolted stuffing box



0.1 GPM

DIAPHRAGM OPERATED NEEDLE VALVES

- Reduced Area Inner Valves to 1/16" effective orifice diameter
- Low rate of flow valves accurately sized and tested
- Test calibration curves on request
- Specialty designs for specific problems

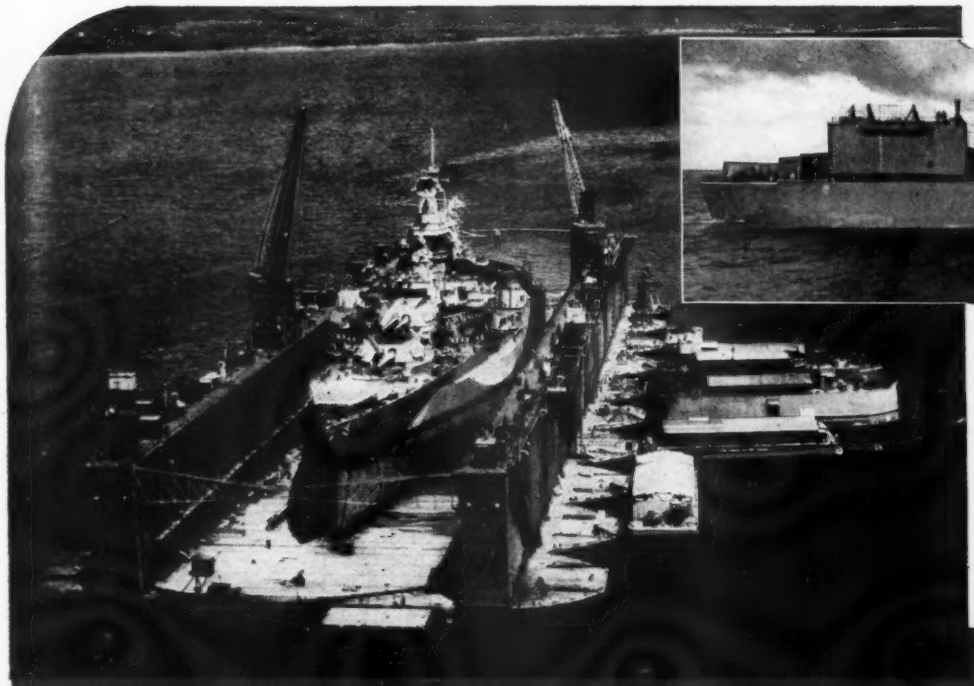
Consult Hammel-Dahl Engineers Regarding Your Individual Problems

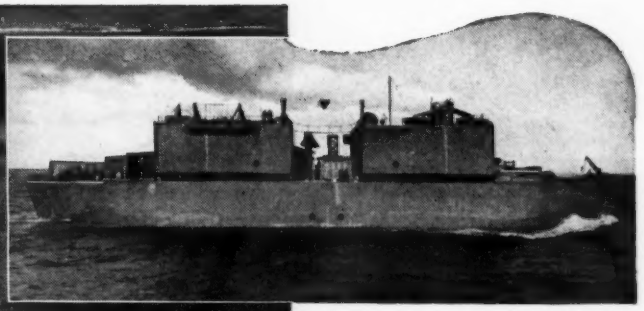
HAMMEL-DAHL CO

240 RICHMOND STREET PROVIDENCE 3 R. I.

LOS ANGELES SAN FRANCISCO PORTLAND, OREGON

NEW YORK WILMINGTON, DEL.





Above: A section of the floating dry dock being towed to forward area by Liberty Ship in convoy.

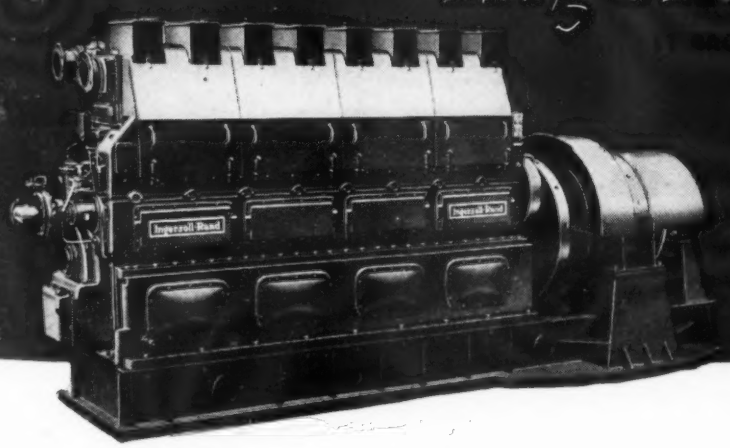
Left: Ten sections welded together at advance base will handle Navy's largest ship.

KEEPING 'EM *in fighting trim*

When the air-tight hulls submerge, the damaged fighting craft enters the dry dock ...Water is then pumped out and the buoyancy of the hulls lifts the dry dock to the surface... Repairs are completed and another warship is ready for more action...

These "floating hospitals" accommodate our largest battleships at advanced bases. In one eight-month period they handled 176 ships.

All of this takes dependable power to operate the pumps and cranes and tools necessary for ship repairs. Each hull has its Diesel-electric power plant—ninety per cent of these are Ingersoll-Rand Type "S" Diesels.



Ingersoll-Rand

ROCK DRILLS
AIR TOOLS
COMPRESSORS
CONDENSERS
TURBO BLOWERS

7-713

READY with the RIGHT tools

Season's Greetings and Sincere Wishes that the new year will bring abundant Happiness and Prosperity to our many friends in industry, engineering and the building fields.

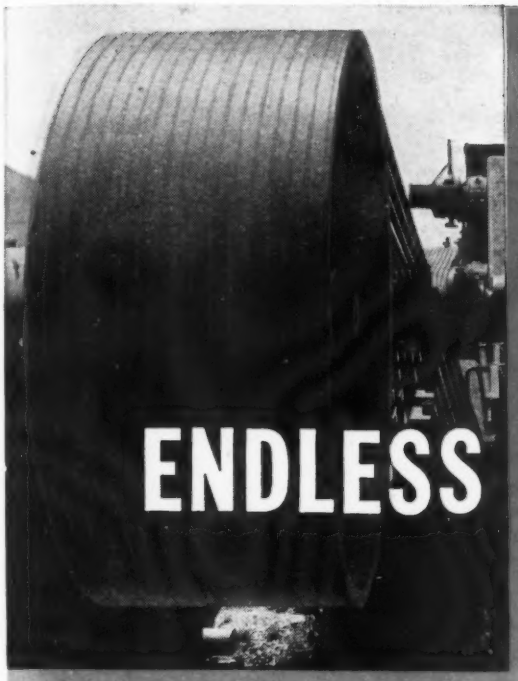
Looking ahead to the first full year of peace... it is our hope that it will be a full year of bountiful production and progress throughout America.

As new building gains momentum... we'll do our best to keep pace with your demands for the complete line of TOLEDO Threaders. In the future, as in the past, TOLEDO Pipe Tools will be engineered and built for unbeatable performance—to do the job *faster, better* and *cut costs!* The Toledo Pipe Threading Machine Company, Toledo, Ohio. New York Office, No. 2 Rector Street Building.

RELY ON THE LEADER

TOLEDO

FOR PRECISION PIPE TOOLS



Gilmer

ENDLESS MULTIPLE V-BELTS

built for Power and Endurance

Whether your V-Belt drives call for a few or many belts, you can count on steady, dependable performance when tough, firm gripping, well-matched Gilmer V-Belts pull the load. And regardless of the length, power or speed of the drives, you can obtain the right belts to fit them . . . for Gilmer has the largest assortment of V-mould sizes in the world.

The special design and extra sturdy construction of Gilmer Multiple V-Belts assure maximum life and economy. And the Gilmer process of precision moulding provides "matched" lengths to within very small tolerances.

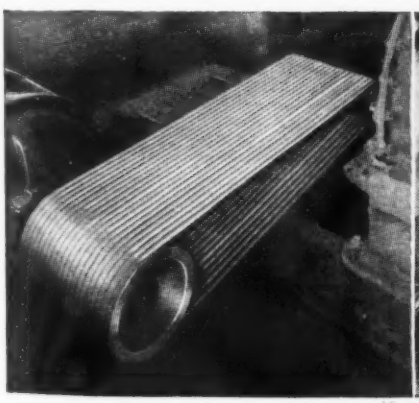
Gilmer also manufactures FHP V-Belts in a wide range of sizes to meet practically every application. When desired, any Gilmer V-Belt will be supplied specially treated to withstand conditions of excessive oil, heat, static, etc.

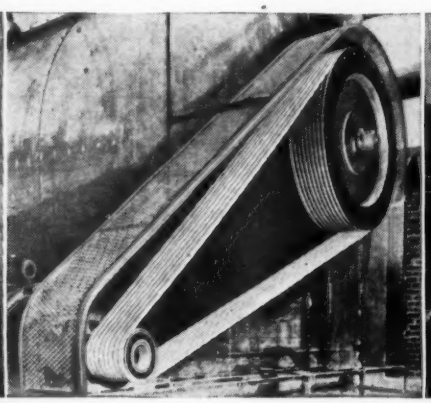
Write for a FREE copy of the Gilmer Guide, the most complete V-Belt catalog ever published. It contains valuable data that will prove helpful to every power plant engineer.

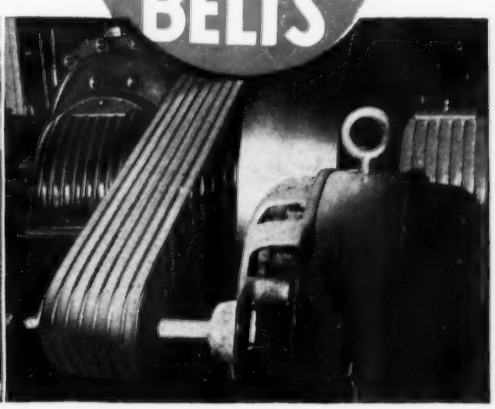
There are Gilmer Belts for every power transmission need

L. H. GILMER COMPANY
Tacony, Philadelphia 35, Pa.
Division of United States Rubber Company

Gilmer BELTS

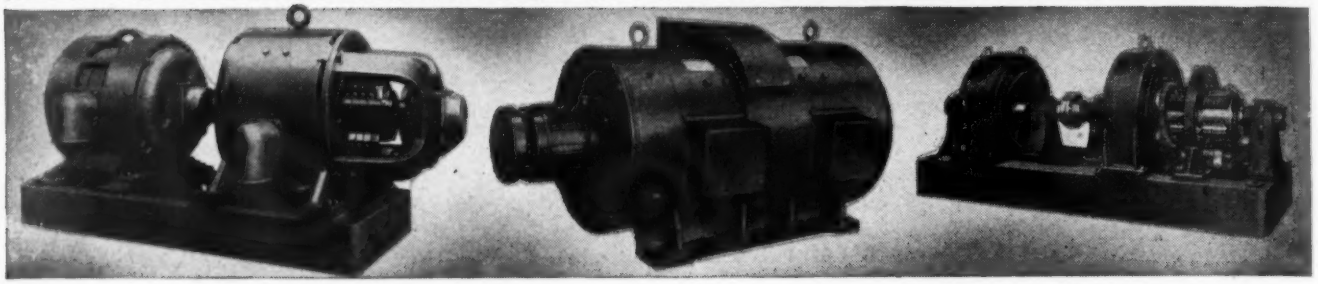




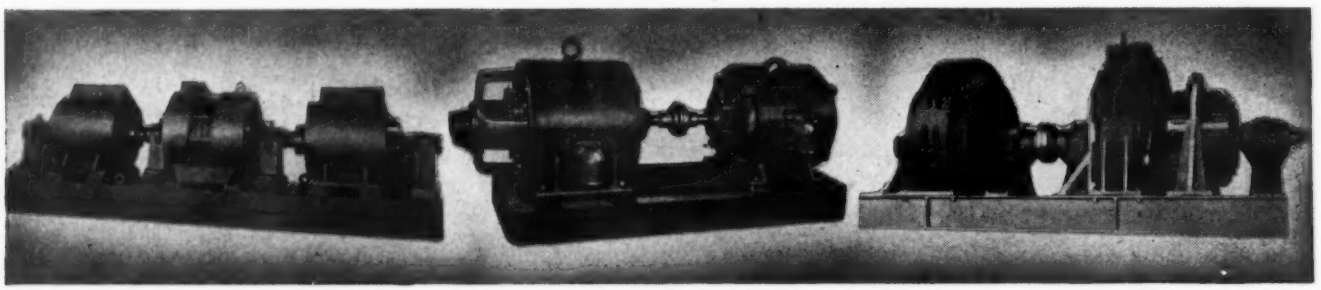


THERE'S ONE CORRECT M—G SET

• *that best fits into your plant*



75 k.w. M-G Set Induction Motor Driven
300 k.w. 3 Unit Synchronous Motor Driven
25 k.v.a., D.C. to A.C. 2-Bearing M-G Set
5 k.w. Exciter M-G Set
500 k.w. Synchronous Motor Driven M-G Set
1000 k.w. Synchronous Motor Driven



BURKE IS GEARED TO BUILD IT

ABOVE are illustrated a few typical Burke M-G Sets. These will remind you that Burke is able to meet your most exacting specifications up to capacities of 1000 KW. Burke, one of the oldest and largest independent builders of synchronous equipment and a pioneer in the manufacture of DC equipment, has the experience to design and build the correct M-G set for your power needs. State K W and voltage desired on generator and voltage, phase and cycle for motor drive — describe the application to be made.

For a description of the complete Burke line of AC and DC motors and generators, consult Sweet's Engineering catalogs or Electrical Buyers Reference catalog.

For immediate assistance, telephone our nearest representative:

BURKE AGENTS AND REPRESENTATIVES

ATLANTIC ENG. CO.
185 17th Street N. E., Atlanta, Ga., Phone: Hemlock 6461
C. E. WINCHELL
205 Perry-Payne Bldg., Cleveland, O., Phone: Cherry 5634
INDUSTRIAL EQUIP. CO.
6823 Navigation Blvd., P. O. Box 9155, Houston, Texas, Phone: Woodcrest 62693
BURKE ELECTRIC CO.
Room 234, 1600 Arch St., Philadelphia, Pa.
Phone: Rittenhouse 5226
P. A. MORSE
Fullerton Bldg., Room 600, St. Louis, Missouri
Phone: Garfield 0076
BURKE ELECTRIC CO.
Room 1515, Engineering Bldg., Chicago, Illinois
Phone: Franklin 5061
BURKE ELECTRIC CO.
Roosevelt Theatre Bldg., Detroit, Mich., Phone Plaza 7232
BURKE ELECTRIC CO.
Room 1704, 274 Madison Ave., New York City, N. Y.
Phone: Lexington 2-5330
F. E. BURKE
416 Maple Ave., Pittsburgh 18, Pa., Phone: PEnhurst 5357
NORTHWESTERN AGENCIES
2411 First Avenue, Seattle, Washington
Phone: Eliot 8882

MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*

LESS FINISHING

WITH SIVYER "PATTERN-TRUE" CASTINGS

★When you specify Sivyer castings, you can be sure of castings of blueprint accuracy—castings measuring true to pattern shape, contour and dimensions.

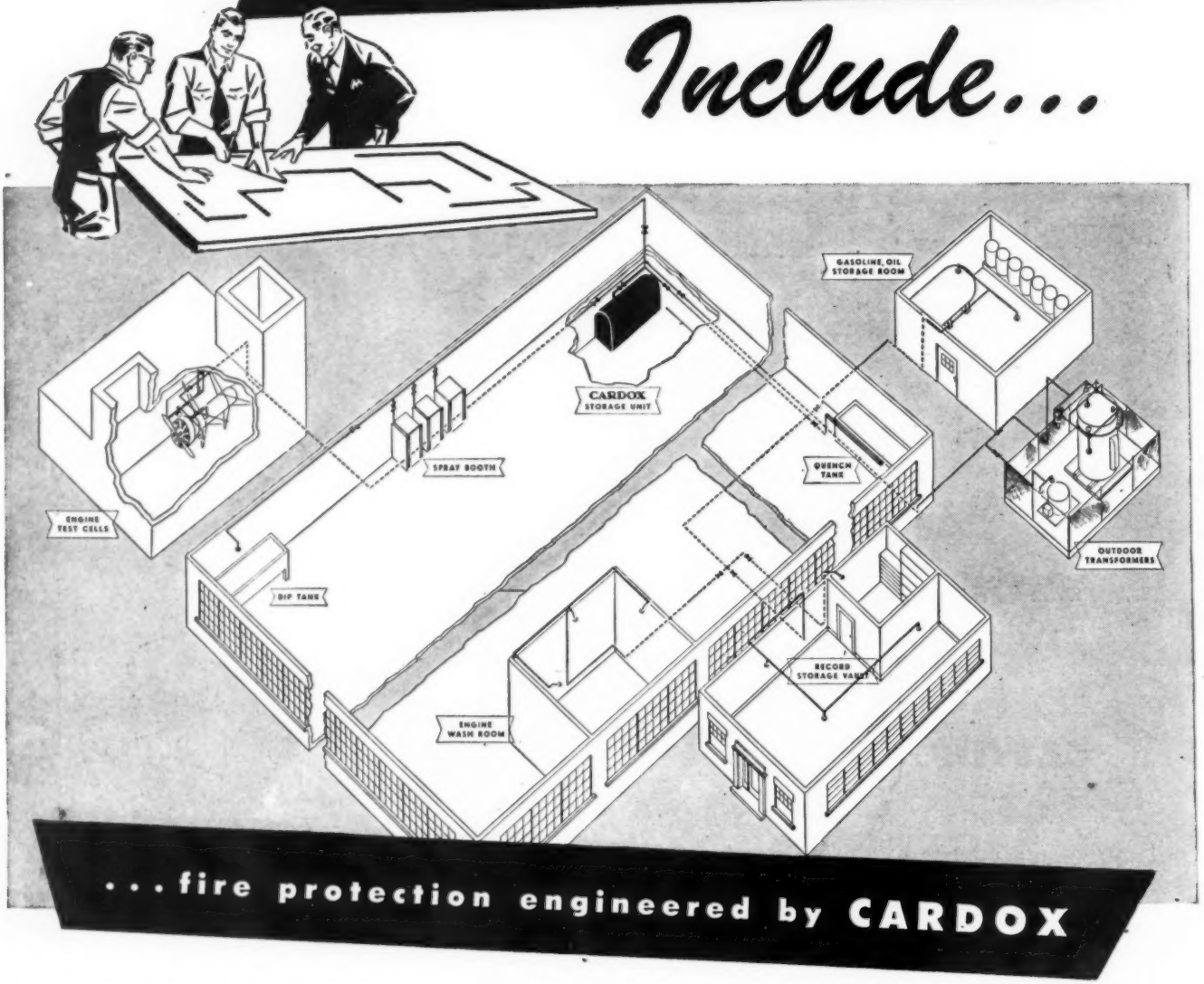
This extra degree of finishing found in Sivyer steel castings—finishing that goes beyond the point of usual foundry practice—means less expensive handling, less processing at your end . . . means castings that get on the job faster.

And on the job, too, you save with Sivyer castings. For they're longer lasting castings—the products of nearly 37 years of casting experience and skill . . . of the most modern in scientific testing and control.

The next time, try Sivyer.

SIVYER STEEL CASTING COMPANY
MILWAUKEE CHICAGO

THE BEST LAID PLANS *Include...*



. . . fire protection engineered by CARDOX

Inexpensive carbon dioxide is widely recognized as the ideal fire extinguishing medium for a wide variety of fire hazards. It is fast, non-damaging and inexpensive.

But, where a few pounds, properly applied, will stop one fire, another may call for *tons* . . . all released in the fire zone in a matter of *seconds!*

Through Cardox methods of control and engineered application the multiple advantages of carbon dioxide . . . supplied instantly in *pounds* for small fires, in *tons* for large ones . . . are given enhanced performance and greatly broadened scope of usefulness.

A Cardox System—engineered for the specific hazards it covers—extinguishes fires by a timed *mass* discharge of Cardox CO_2, stored at 0°F. and 300 p.s.i. in a single storage unit of ¼ to 125 ton capacity. Thus, an ample quantity of liquid carbon dioxide is available for mass application at high rate for large critical areas or for multiple hazards . . . *with ample reserves for new emergencies.*

Cardox CO_2 has uniform extinguishing characteristics regardless of plant or atmospheric conditions. Cardox applications can thus be most effectively engineered in accordance with individual hazard requirements . . . even in the case of a combination of hazards as unusually diversified as those shown in the schematic view above.

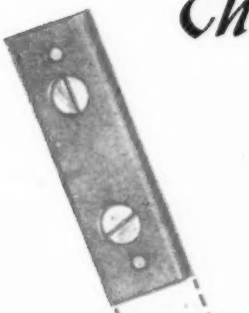
Executives now developing postwar building plans are invited to draw on the Cardox Research Division and Engineering Staff for practical cooperation in planning fire extinguishing facilities engineered for maximum protection of the specific hazards involved.

CARDOX CORPORATION
BELL BUILDING • CHICAGO 1, ILLINOIS
DISTRICT OFFICES IN
New York • Philadelphia • Washington • Pittsburgh
Cincinnati • Cleveland • Detroit • Houston
Seattle • San Francisco • Los Angeles • San Diego

Cardox CO_2 is supplied instantly in pounds or tons from a single Storage Unit containing 500 pounds to 125 tons at controlled low temperature of 0°F. and 300 p.s.i.

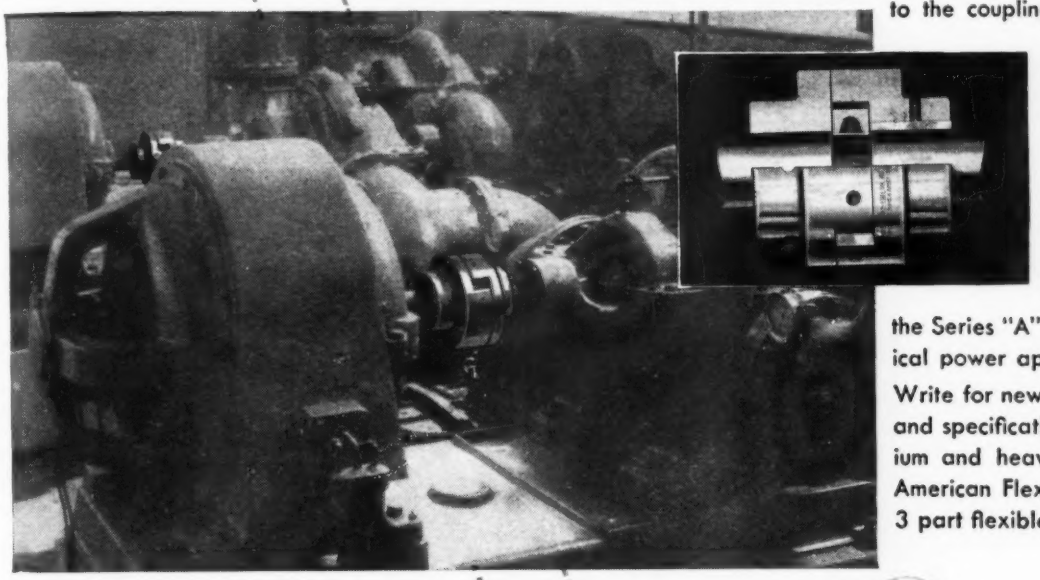
CARDOX
CO_2 FIRE EXTINGUISHING SYSTEMS

The Secret of AMERICAN · *2+1=3*



ONLY AMERICAN FLEXIBLE COUPLINGS have two identical jaw flanges connected by one square floating center member. Three sturdy parts of the correct materials for each of the three applications - for average mechanical power applications - for medium torque transmitting applications - for most severe mechanical power applications.

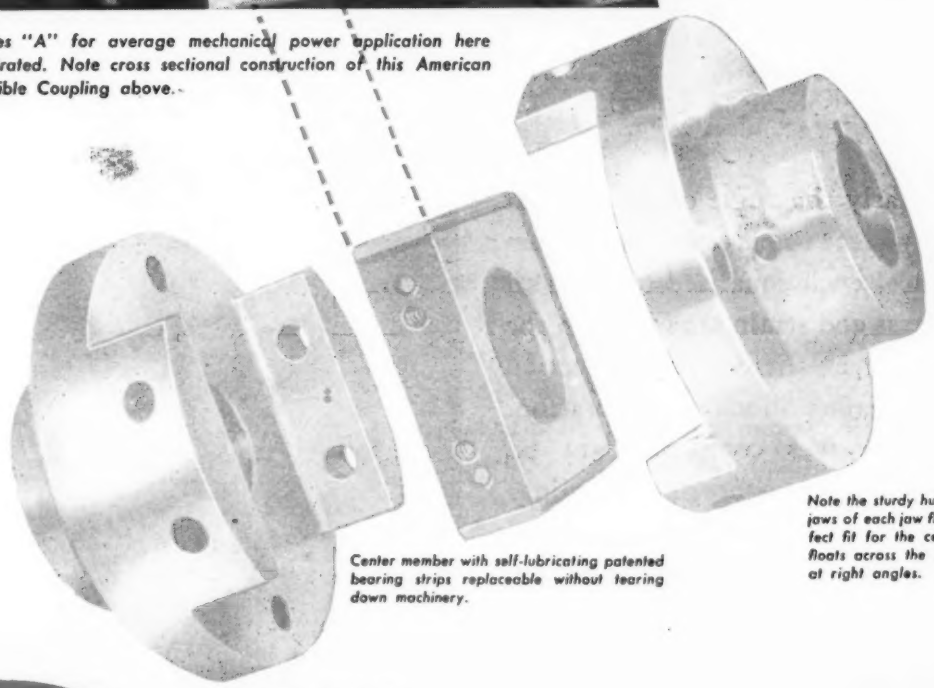
Illustrated here is the unique feature of the square floating center member . . . A centrifugal lubrication unit of high strength alloy metals. This replaceable self-lubricating bearing strip on each of the four sides of the center member assures long life to the coupling . . . Can be replaced without tearing down the unit or disturbing connected machines.



In this particular application illustrated, the jaw flanges are high strength alloy iron, and the center member is high strength alloy iron as well. This is the Series "A" for the average mechanical power application.

Write for new bulletin giving full details and specifications on this and the medium and heavy power applications of American Flexible Couplings . . . the only 3 part flexible couplings.

Series "A" for average mechanical power application here illustrated. Note cross sectional construction of this American Flexible Coupling above.



Center member with self-lubricating patented bearing strips replaceable without tearing down machinery.

Note the sturdy hubs and the machined jaws of each jaw flange offering a perfect fit for the center member which floats across the face of each flange at right angles.

Note the two parallel jaws of the jaw flanges which hold the center member.

ZURN

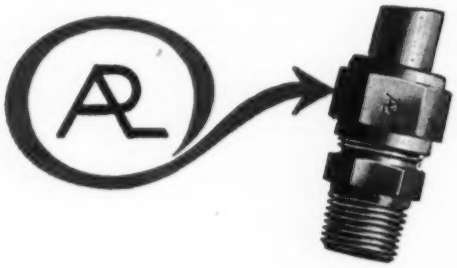
AMERICAN FLEXIBLE COUPLING CO.
DIVISION OF
J. A. ZURN MFG. CO., ERIE, PENNA.

Select

THE TUBING THAT FITS THE JOB AND THE COUPLING THAT FITS THE TUBING

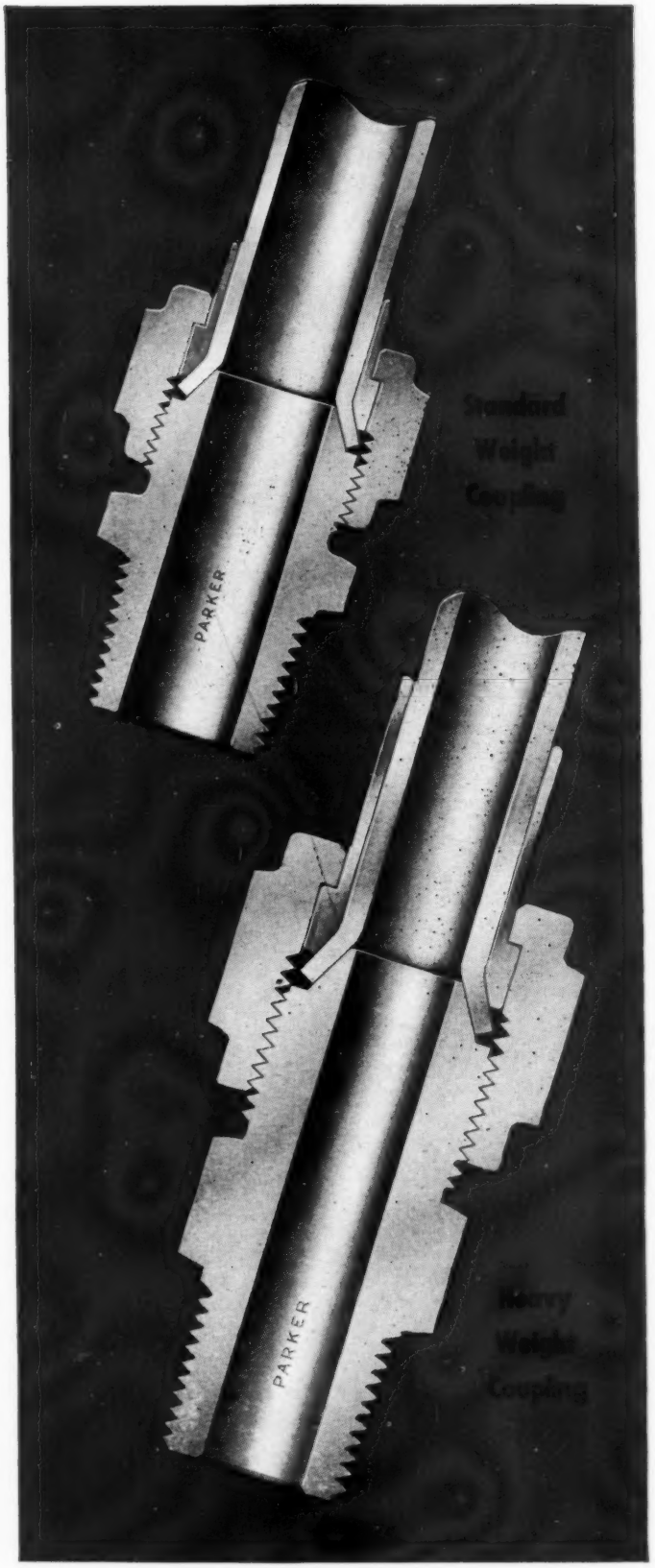
That's sound engineering—sound Fluid Power engineering. It means a tubing system that insures smooth, streamlined flow, with leak-tight and vibration—proof joints, plus easy installation and maintenance.

The Parker trade mark is your assurance of getting exclusive and patented Parker design features that set the standard for Army-Navy aircraft and ordnance use.



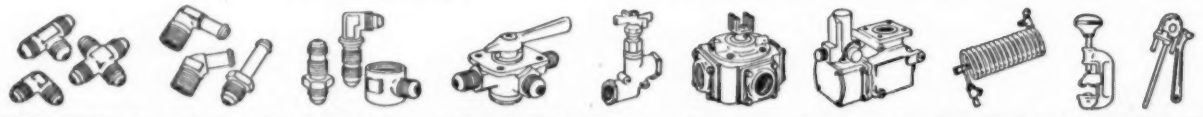
Note particularly the angle of the flare. It is scientifically set to provide maximum clamping surface, with equalized pressure all around. All stress and strain are taken on the body, nut and sleeve—there is full protection for the system against shock and vibration.

Catalog 201-C gives complete data on *standard weight* and *heavyweight* triple couplings —1/8" to 1½"—in steel, brass, stainless steel and aluminum. Ask your jobber or write to The Parker Appliance Company, 17325 Euclid Avenue, Cleveland 12, Ohio.

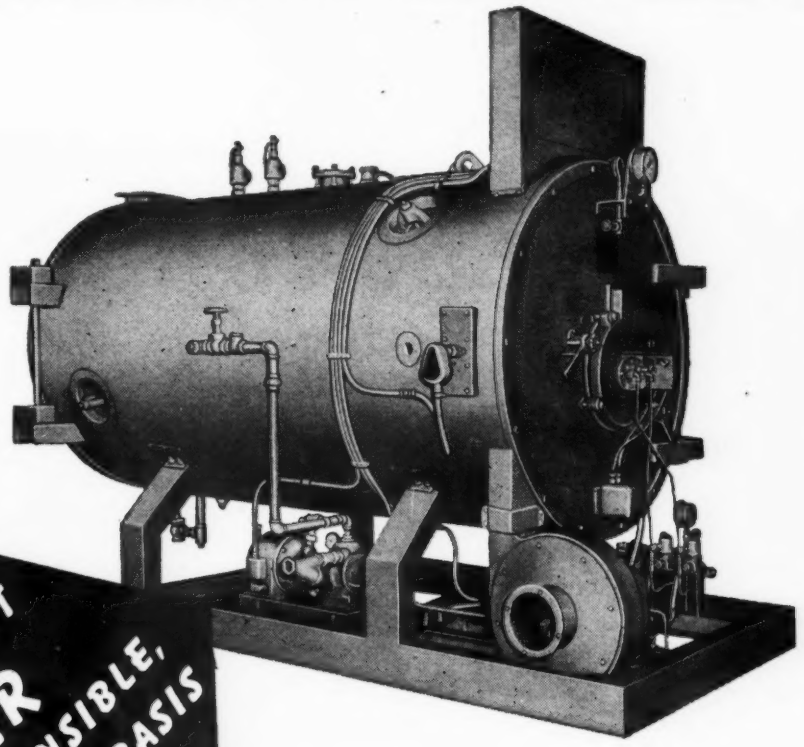


THE PARKER APPLIANCE CO.

CLEVELAND • LOS ANGELES



FLUID POWER PRODUCTS FOR ALL INDUSTRY



IF YOU WANT **POWER** ON A SENSIBLE, LOW-COST BASIS

AMESTEAM *Generator*

The AMESTEAM Generator is a wonderful power plant. In one self-contained unit, it provides all the features that any small or medium-sized plant may require!

It takes a minimum of manpower at all times, because it's easy to install, easy to operate, easy to repair. And it delivers a maximum of power because of the excellence of its design and manufacture. It gives steam *rapidly* . . . and with complete cleanliness . . . and requires no expensive foundation or stack.

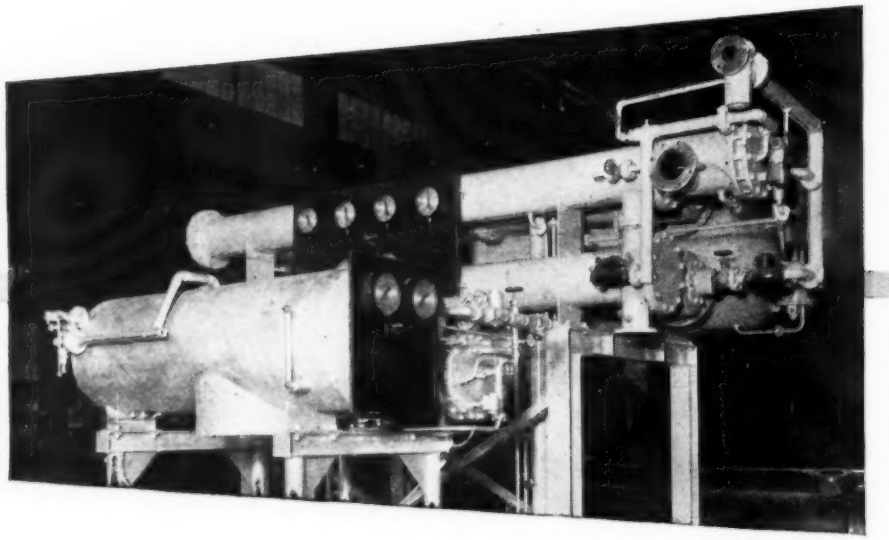
Available in units from 10 to 300 horsepower, it provides power, on a sensible, low-cost basis . . . and it is backed by Ames' 100 years of experience. Write or phone for full information.

AMES IRON WORKS

BOX B1 OSWEGO, NEW YORK

BOILING WATER AT 38° F. IN A ROSS DECALORATOR

IS A CASE IN POINT FOR ALL INDUSTRIES AND POWER PLANTS



Why does water boil at 38°F. in a Ross Decalorator? It boils because of the extremely low absolute pressure maintained by a Ross Three-Stage Steam Jet Ejector.

This low absolute pressure is maintained more dependably and economically than with any other type of vacuum pump.

It's a case in point for all industries and power plants, because this same Ross Ejector (single or multi-stage, operating with or without Ross inter and after condensers of the surface or barometric type) is one of the most simple, efficient and economical vacuum pumps for removing air, vapors or gases. This applies to the handling of many types of mixtures: wet or dry, slightly sticky or solid. Only steam or water need be available for efficient operation. Little or no supervision and maintenance are required.

Consult Ross' engineers about the particular advantages of Steam Jet Ejectors: in *power plants* as air removal equipment on surface or barometric condensers, and as pump primers; in *chemical, food and petroleum* industries for vacuum distillation, deodorization, deaeration, degasification, dehydration, concentration, evaporation, impregnation, vacuum packing and vacuum cooling. You will be furnished with information and recommendations based on long experience in these specialized fields.

ROSS

Ross equipment is manufactured and sold in Canada by Horton Steel Works, Ltd., Fort Erie, Ont.

ROSS HEATER & MFG. CO., INC.

Division of American Radiator & Standard Sanitary Corporation

1415 WEST AVENUE BUFFALO 13, N. Y.

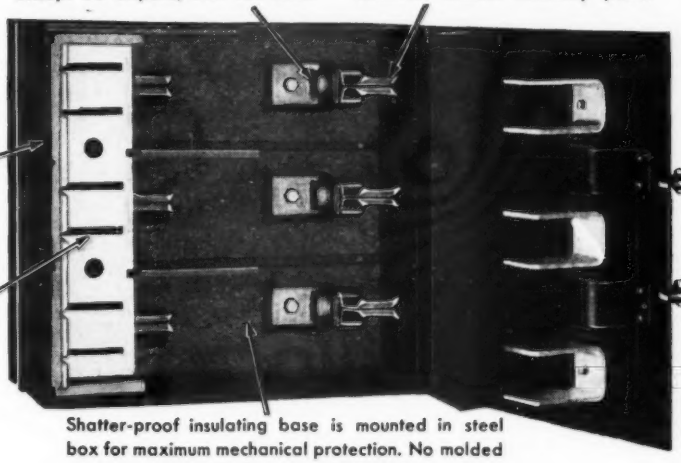
Notice the sound design and rugged construction of this Saflex Switch Unit

A good reason for choosing Saflex Distribution Panelboards

Solder-solderless lugs can be used either as solderless connectors or as solder lugs or both. Furnished on all except 30 ampere, 250 volt units.

Positive pressure fuse clips have high conductivity and assure automatic contact pressure at the fuse terminals without auxiliary parts.

Cam-action provided by handles near switch jaws where it is most needed. This cam-action supplies (with minimum manual effort) the considerable force necessary to provide high contact pressure.



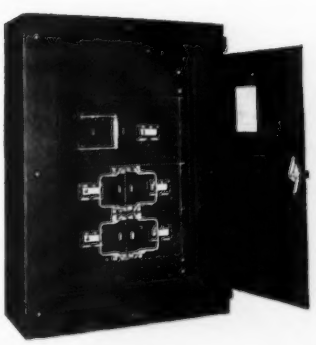
Cover can be locked in either the ON or OFF position by means of a padlock on the bracket.

Arc suppressor block greatly increases the rupturing capacity.

Ranging from 30 to 600 amperes, Saflex Switch units are for use in systems up to 575 volts A.C. or 250 volts D.C.

Shatter-proof insulating base is mounted in steel box for maximum mechanical protection. No molded parts are exposed when cover is closed.

● Notice how simplicity, sturdiness, and safety are built into Saflex Switch units. Opening and closing unit doors operates switch units. Door is permanently anchored; it carries switch blade assembly only, and covers all live parts when closed. When door is open, all accessible live current-carrying parts are dead. All circuits may be opened safely under maximum load. All poles are broken simultaneously, preventing single-phasing. All units except 600 ampere size have rotary switch units. Yale locks on panel cabinet doors prevent unauthorized access. • For fast, simple installation, panel box has oversize wiring gutters and may be shipped separately for roughing in during early stages of construction. Interior and front are separate units, and may be installed later.



Write for Bulletin 2500. Address Square D Company, 6060 Rivard Street, Detroit 11, Michigan.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

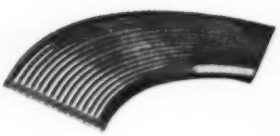
BRING "U.S." YOUR GASKET PROBLEMS!!

Corrugated

Corrugated Asbestos

Corrugated Double Jacket Metal-Asbestos

Solid Metal



Serrated Metal or Profile

QUANTITY?

One or a million.

MATERIAL?

Metal, asbestos, fiber, rubber — anything.

SIZE? SHAPE?

We have it or can make it.

APPLICATION?

Our Gasket Engineers know the answers!

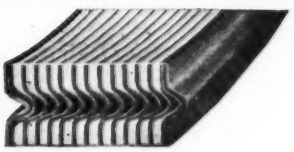
Send a sample gasket, a drawing, a description of the application (or all three) with your inquiry. That is all we need to give you the RIGHT gaskets for your particular service.

UNITED STATES GASKET CO.

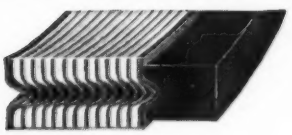
1592 PIERCE AVENUE
CAMDEN, NEW JERSEY

Asbestos

French Type



AJAX Spiral Wound



AJAX S-R Spiral Wound

Oval Solid Metal Ring Type

Single Jacket Metal-Asbestos

Double Jacket Metal-Asbestos

Octagonal Solid Metal Ring Type

EXPLOSION PREVENTER

New - - more efficient - - now available

Oil burner explosions spring from flame failure inadequately monitored. Ordinary controls wait for temperature changes — give the combustion chamber time to become charged with dangerous gases which may wreak havoc. Fireye Photoelectric Flame Safeguard, however, watches the flame itself — shuts down the burner when that flame fails. The new Fireye F-18-E brings to commercial and industrial burners the latest postwar engineering features. A built-in time-delay overlooks flame flicker, eliminates needless alarms and false shutdowns — yet remains well within the few seconds of absolute safety. A new lens system gives added cleaning convenience and more efficient operation. A pilot light indicates safety shutdown at a glance. Low water cut-off equipment — electronic and floatless — may be added at any time. From every angle this new streamlined Fireye is the flame safeguard of tomorrow — proved and ready today.

F-5

Combustion Control Corporation • **Cambridge 42, Mass.**

District Offices in all Principal Cities

photoelectric fireye flame safeguard

The Symbol That Came *To Life!*

The man who walks into your factory wearing this symbol is the living embodiment of a service which gives you the correct answers to your problems in efficient mechanical transmission of power. He's the Dodge *Transmissioneer.*

DODGE
MISHAWAKA

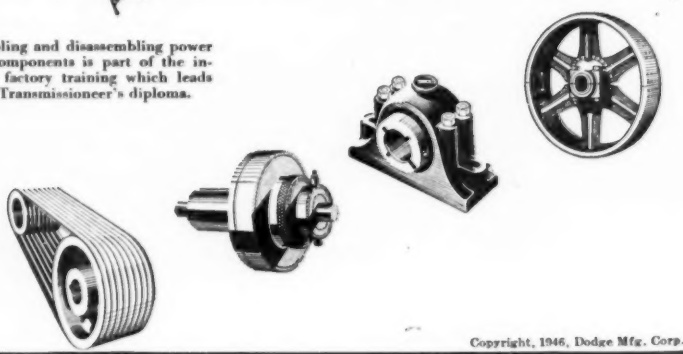
Supporting the Transmissioneer is a broad line of mechanical power transmission equipment — Dodge precision-built bearings, sheaves, pulleys, clutches and other drive components. Every Dodge product reflects the engineering advancements and manufacturing "know how" that come from 64 years of experience.

Your Transmissioneer is qualified to select the power drive equipment which best meets your specific needs. His knowledge and experience, plus Dodge products, provide the up-to-date solution of your power transmission problems.

Look in the classified telephone directory under "Power Transmission Equipment" for the Transmissioneer in your territory. He will advise you, without obligation. Your needs can usually be supplied from Dodge distributors' stocks. Transmissioneered means advanced design in power drives.

DODGE MANUFACTURING CORP., MISHAWAKA, IND.

Assembling and disassembling power drive components is part of the intensive factory training which leads to a Transmissioneer's diploma.



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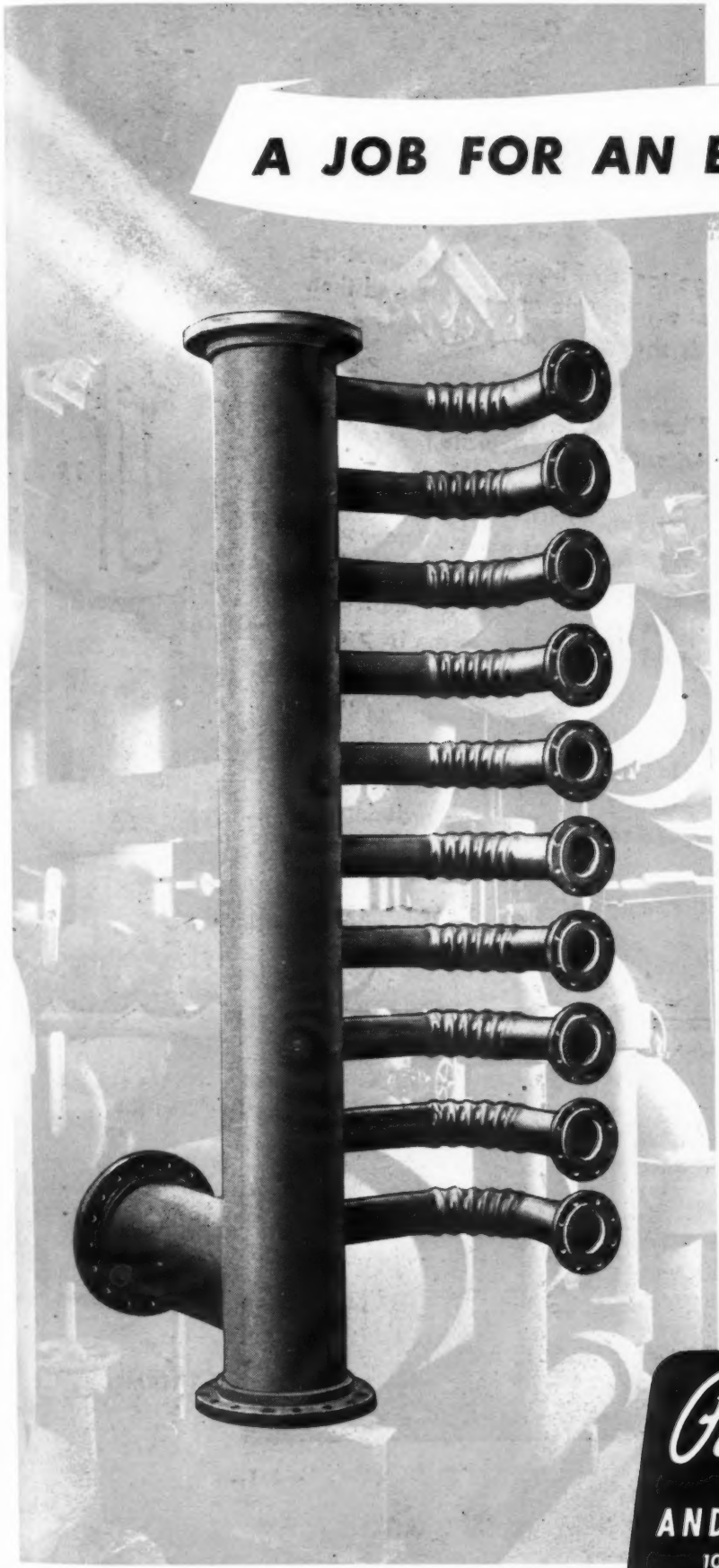
ETCHING COMPANY OF AMERICA, 1520 MONTANA STREET, CHICAGO 14, ILLINOIS

NAME PLATES



A JOB FOR AN EXPERT...

Only trained specialists with modern facilities can be safely entrusted with prefabrication of complex piping assemblies . . . .

PREFABRICATION is the answer to complicated piping jobs — and the more complicated and difficult the job, the more important it is that you entrust it only to Experienced Fabricators, a seasoned expert like Pittsburgh Piping and Equipment Co.

All fabricated assemblies are designed by our Engineering Department to meet specifications and code requirements. Working stresses are carefully calculated, to insure the most efficient utilization of materials for the pressure and temperature conditions involved.

The work is done by trained specialists, with every modern facility for bending, welding, creasing, corrugating, stress relieving, Van Stoning, machining, heat treating and testing and inspecting.

The Laboratory complements the Engineering and Production Departments, by developing basic procedures and subjecting them to every known test. These procedures are applied, under laboratory control, to the fabricated assembly, and all materials are subjected to exacting tests to insure conformity to specifications and codes.

When you get your piping prefabricated by Pittsburgh Piping & Equipment Company, you are assured of fit, of performance, and of long-life economy.

Pittsburgh Piping

AND EQUIPMENT COMPANY

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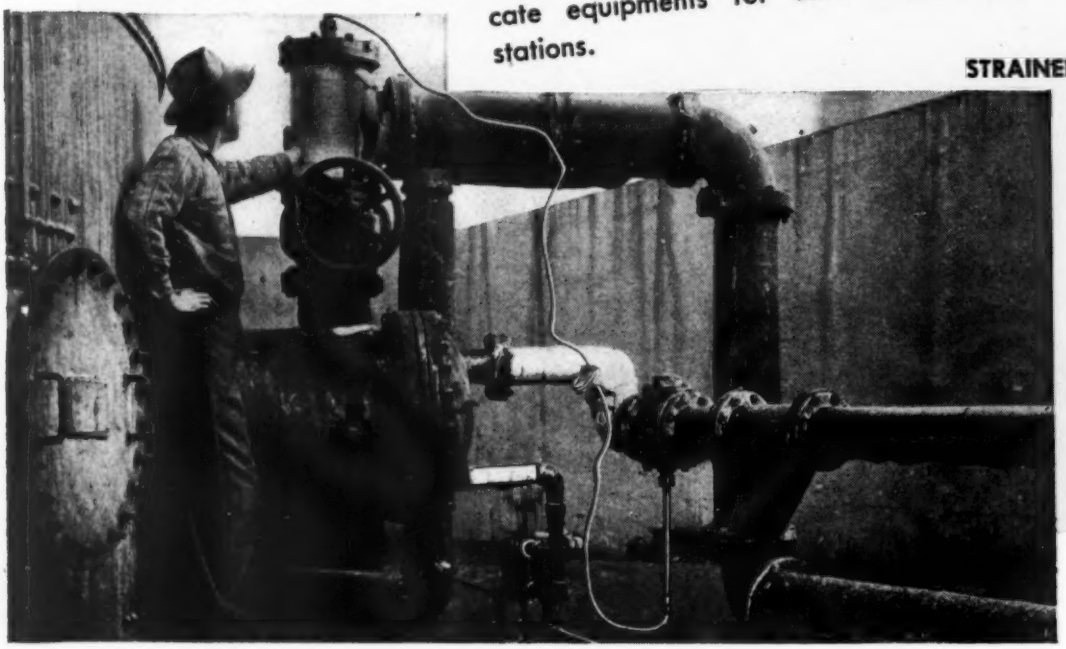
★ BUY VICTORY BONDS ★

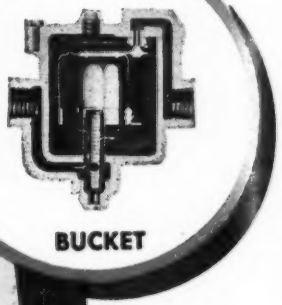
WHAT MESSAGE HAS THIS TANK . . . FOR YOU?

In dozens of industries there are large tanks of liquid which cannot be pumped unless heated. Pumping is at a high rate one minute and then no action at all for hours. The liquids should be pumped at the exact temperatures.

In the fuel oil industry, it's a "must" because false meter readings may occur at temperatures above 120 degrees. So the accurate and reliable Sarco TR-21 temperature regulator is hooked up to a nest of fin type heating coils inside the tank and of sufficient surface to heat the oil as it flows. The regulator valve is protected by a Sarco strainer. Condensate is removed from the heater coils by a Sarco bucket steam trap fitted with a Sarco Thermodrain set at 40 degrees to prevent freezing. Steam supply line is dripped by a Sarco No. 9 thermostatic steam trap with a Sarco ¾" strainer.

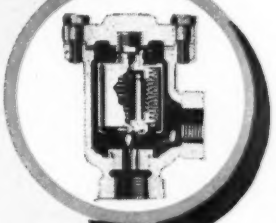
It's a message of co-ordinated efficiency. Seven different, but "blood related" Sarco products working together on one job and the cost according to the manager is already forgotten because of the improved service. They are ordering duplicate equipments for other distributing stations.





BUCKET

TR-21



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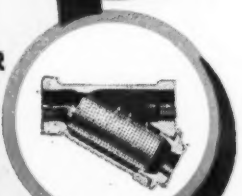
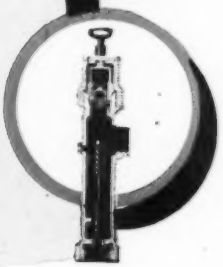


STRAINER



THERMO-DRAIN

105

FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

SARCO SAVES STEAM

Represented in Principal Cities

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...the WALWORTH

No. 225P

The Bronze Valve your money can buy

THE stainless steel, non-corrosive seats and discs of the Walworth Number 225P are heat treated to a hardness of 500 Brinell – hard enough to scratch glass and crush nails.

Because of this extreme hardness the valve is tough enough to be closed on sand, slag, scale, and similar flotage without injury to the seating surfaces, and "wire drawing" is practically eliminated. Even after years of severe service Number 225P will assure tight, positive shut-off.

Union bonnet type construction, plug-type seats and discs, deep stuffing boxes, oversize stems and sturdy bronze bodies assure maximum protection against wear and leakage. Valves may be repacked under pressure, when fully opened. Available in both globe and angle types (angle Type No. 227P) in sizes ¼" to 2", this quality valve is recommended for 350 lbs. superheated steam pressure, maximum temperature 550F, and 1000 lbs. non-shock service on cold water, oil, gas or air.

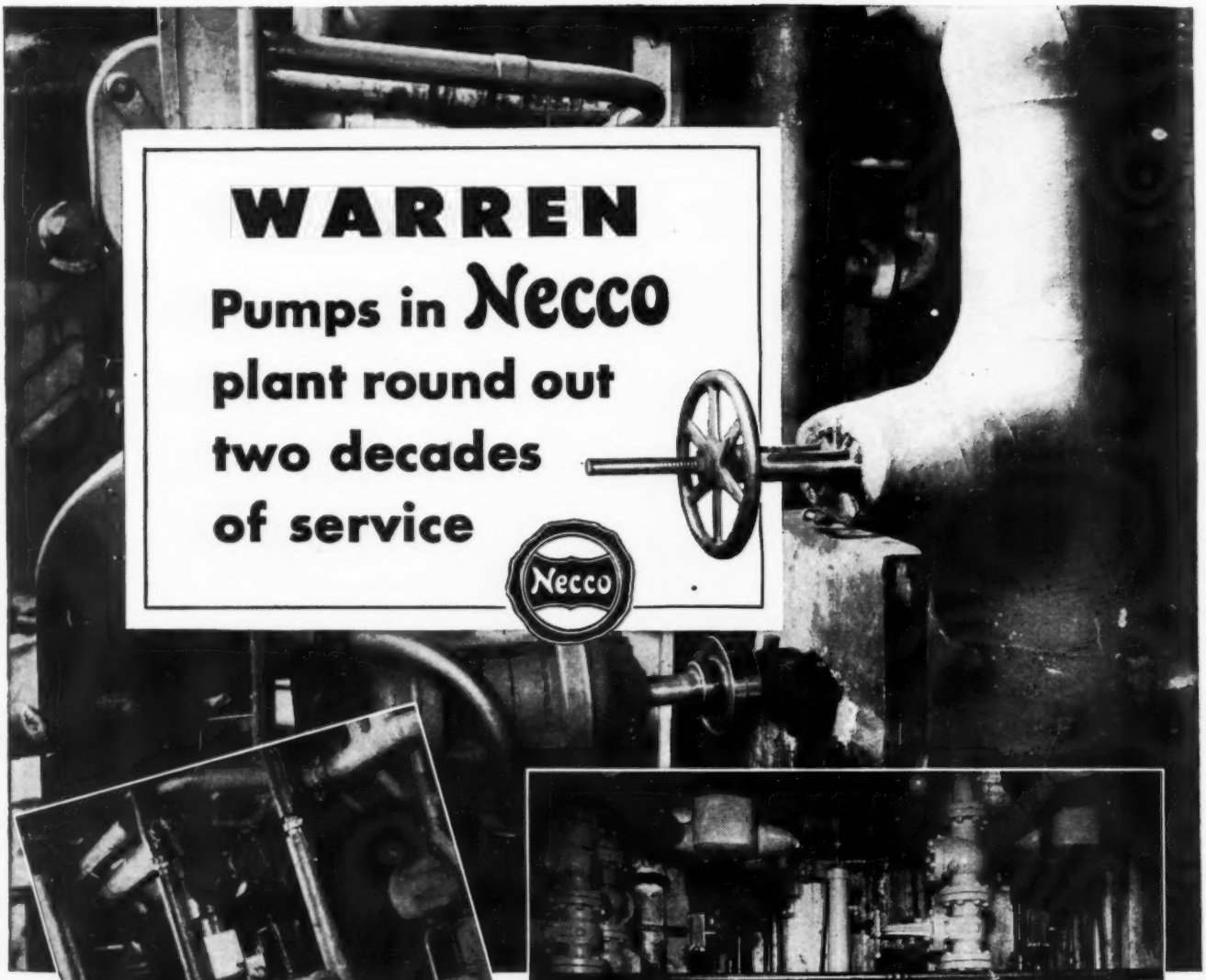
For further information on this long-life, economical Walworth Bronze Valve see your nearby Walworth distributor, or write for Catalog No. 42.

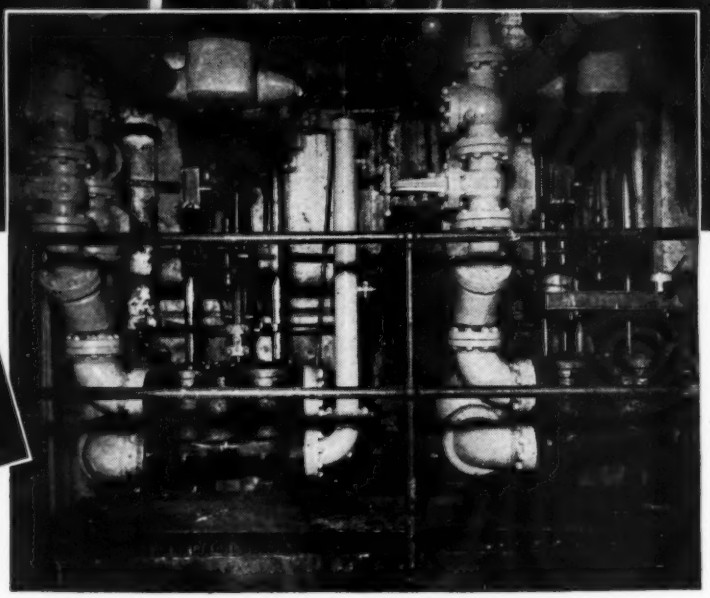
Walworth VALVES AND FITTINGS

60 EAST 42nd STREET, NEW YORK 17, N. Y.

WARREN

Pumps in Necco plant round out two decades of service





Warren Pumps in the New England Confectionery plant in Cambridge, Massachusetts, include Boiler Feed, Condensate, Vacuum, Spray Pond, Chilled Water, Brine, City Water Booster and Process Spray.

Many of these pumps have been in continuous service for more than two decades and show every evidence of their ability to continue serving satisfactorily for many years more.

Whatever your pump problems — put them up to Warren.

WARREN

STEAM PUMP COMPANY, INC.

WARREN, MASSACHUSETTS

American industry flows through fairbanks valves

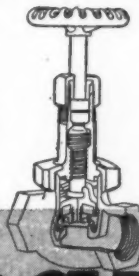
BUILDING... tomorrow's wakening giant

After war's final "cease-firing", look for the building industry to go places . . . for vast cities-within-cities to take shape. They're on drafting boards today.

Air conditioning and ventilating will be widened to include removal of dust, bacteria and odors from the atmosphere by unit-type air sanitation equipment. On the upswing will be radiant heating, zoned heating, service hot water, spot cooling units . . . gas air conditioning which regulates humidity . . . a single heat pump system which heats buildings or cools them as desired.

Controlling liquids and gases in miles-on-miles of tomorrow's piping will be thousands and thousands of Fairbanks Valves. They will have been selected because of topflight past performance . . . because architects and engineers know they can expect freedom from failure when a Fairbanks is installed.

Whether it's a small bronze valve or a huge iron body gate valve with a 24-inch opening the name Fairbanks stands for sound engineering, careful chemical and metallurgical control of alloys, ample metal for the job. The full line is given in catalog "42" which will be sent you if you ask for it. If you need special assistance with individual problems of valve selection and application, call on the facilities of the Fairbanks Engineering Department.



THE fairbanks COMPANY

393 LAFAYETTE STREET, NEW YORK 3, N. Y.

520 Atlantic Ave., Boston 10, Mass. 748 M & M Bldg., Houston 2, Texas 15 Ferry St., Pittsburgh 22, Pa.

LOOK *at this Valve*

WATER-STEAM MIXING VALVE
ENGINEERED DESIGN BY HAMMEL-DAHL

Automatically controlled for safety, the HAMMEL-DAHL Water-Steam Mixing Valve is ideal for industrial processing and washing . . . in chemical plants . . . in laundries . . . in bottling plants . . . and wherever hot water is required . . . for washroom and shower installations where continuous, full flow is required. Its pressure rating is 250 p.s.i. at 400°F. It is exceedingly compact . . . 8½" x 6¾" x 5" and designed for 1" piping, but the valve is available in larger sizes where greater flow of hot water is demanded.

Consult Hammel-Dahl Engineers Regarding Your Individual Problems

CHECK THESE FEATURES

It provides a continuous, controlled flow of hot or warm water, without tank or coils.

It heats water efficiently and economically by mixing water at normal pressure with steam. May be located at any convenient point.

It cannot discharge live steam even should water pressure fail entirely.

It operates efficiently with considerable variations of water and steam pressures.

It holds the discharge within close temperature limits. Predetermined temperature is obtained by a simple, tamper-proof adjustment of the valve.

It provides hot or warm water with greatest economy and at the lowest installation cost.

HAMMEL-DAHL COMPANY

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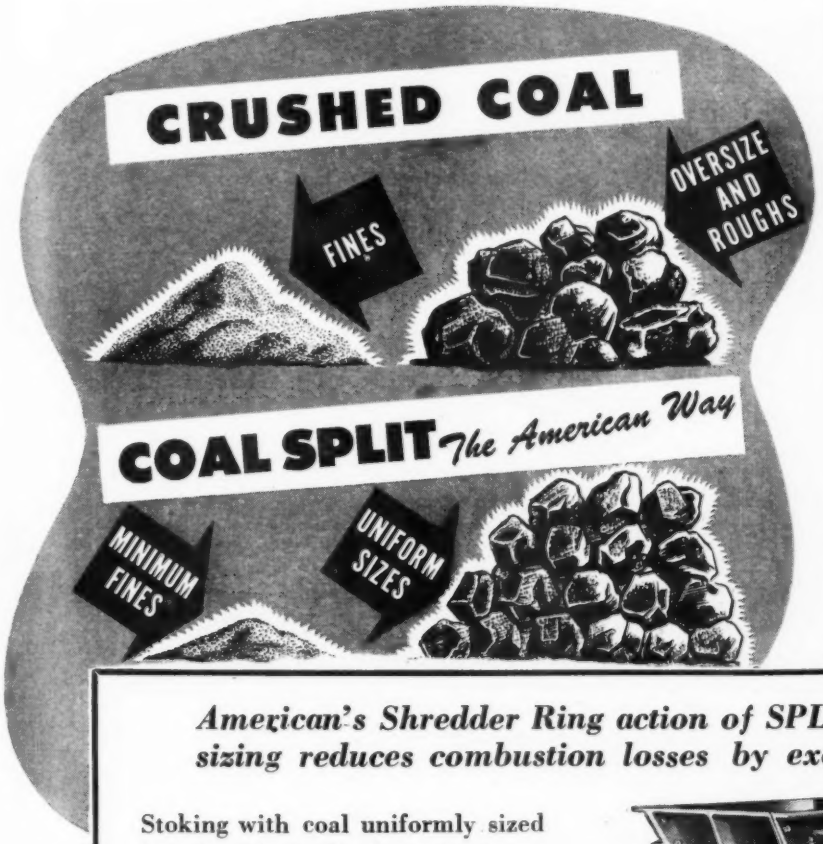
LOS ANGELES • SAN FRANCISCO • PORTLAND, OREGON • WILMINGTON, DEL. • NEW YORK • CHICAGO



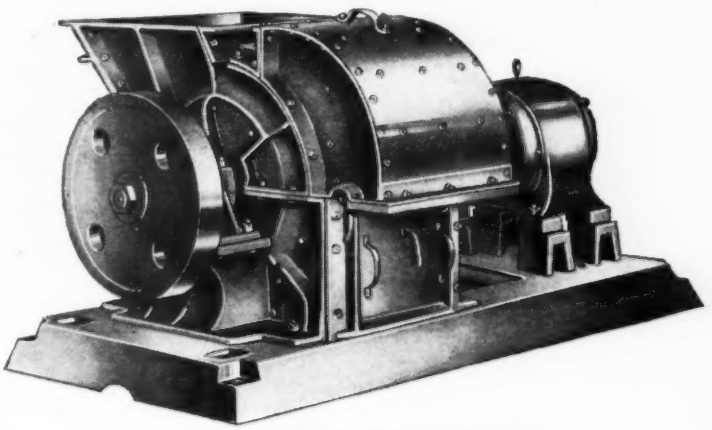
HOW UNIFORM COAL REDUCTION INCREASES COMBUSTION EFFICIENCY

with American Rolling Ring Crushers . . . .

American's Shredder Ring action of SPLITTING coal for uniform sizing reduces combustion losses by excess air and ashpit drop

Stoking with coal uniformly sized by American Crushers *increases firing efficiency from 2½ to 8%*—as shown by a series of actual 24 hour operating tests (by an impartial agency) as recorded with CO_2 charts—in comparison with other types of convential crushers.

The *quality of the crushing* is actually more important than the quality of the coal to efficiency of combustion. Improperly crushed high grade coal can deliver less BTU's per pound than properly crushed coal of uniform size.

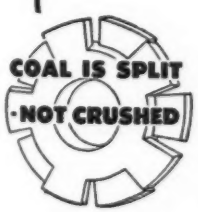


American "S" Crusher

American "S" Crushers especially designed for power plants are built in 9 different sizes—in capacities from 25 to 500 TPH.

The operating cost of American Crushers is less than 1c per ton. Their dynamically balanced rotor construction and *double use* of centrifugal force—rather than high speed—minimizes power demand.

Ask any of the many who operate Americans—all over the world!



AMERICAN'S SHREDDER RINGS

A patented feature exclusive with American Rolling Ring Crushers—Manganese Steel Shredder Rings with 20 cutting edges. Revolving free at terrific centrifugal force, they deflect unharmed in contact with tramp metal. No shear pins or conventional safety devices that require attention.

Send for Informational Bulletin of coal crushing data and specifications

American PULVERIZER COMPANY

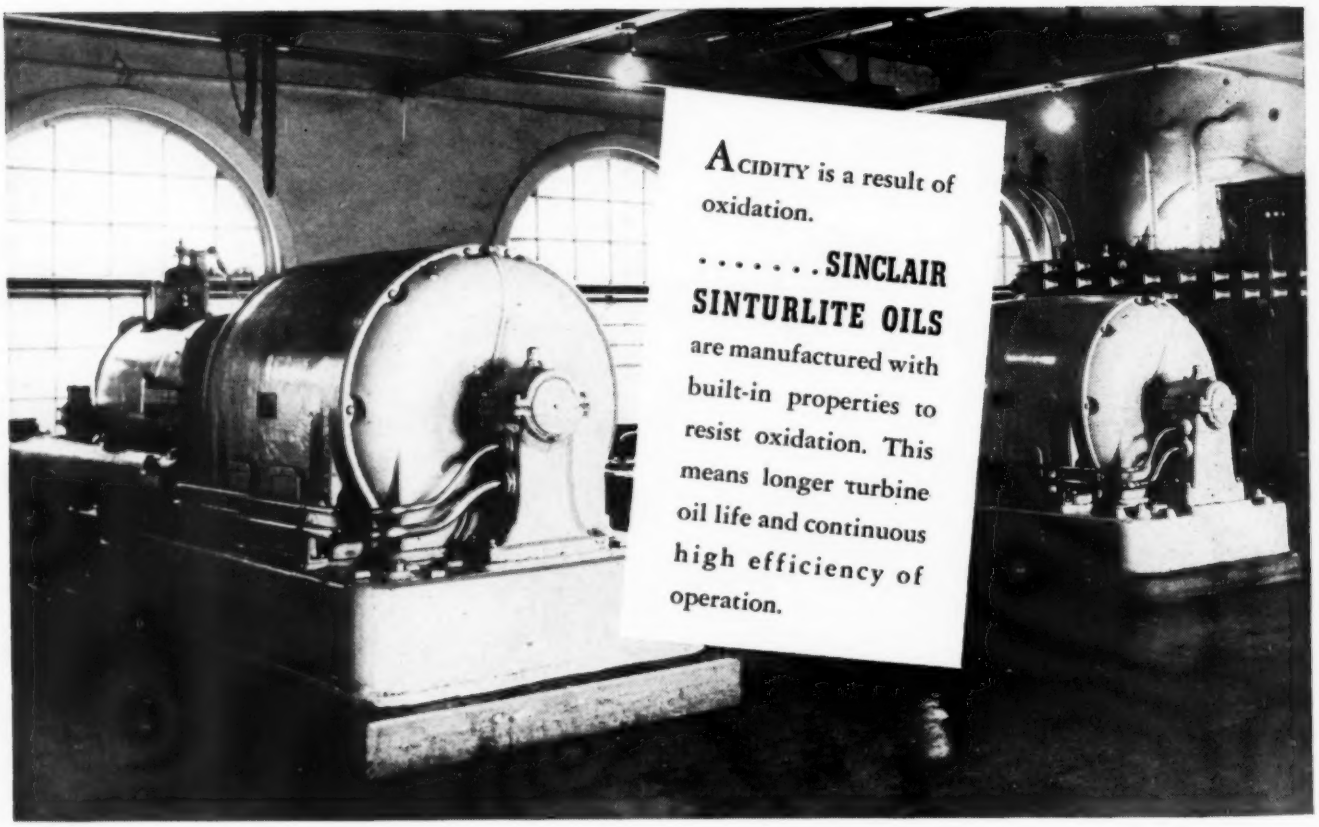
Originators and Manufacturers of Ring Crushers and Pulverizers

1429 Macklind Avenue
St. Louis 10, Mo.

TO COMBAT ACIDITY

SINTURLITE OILS

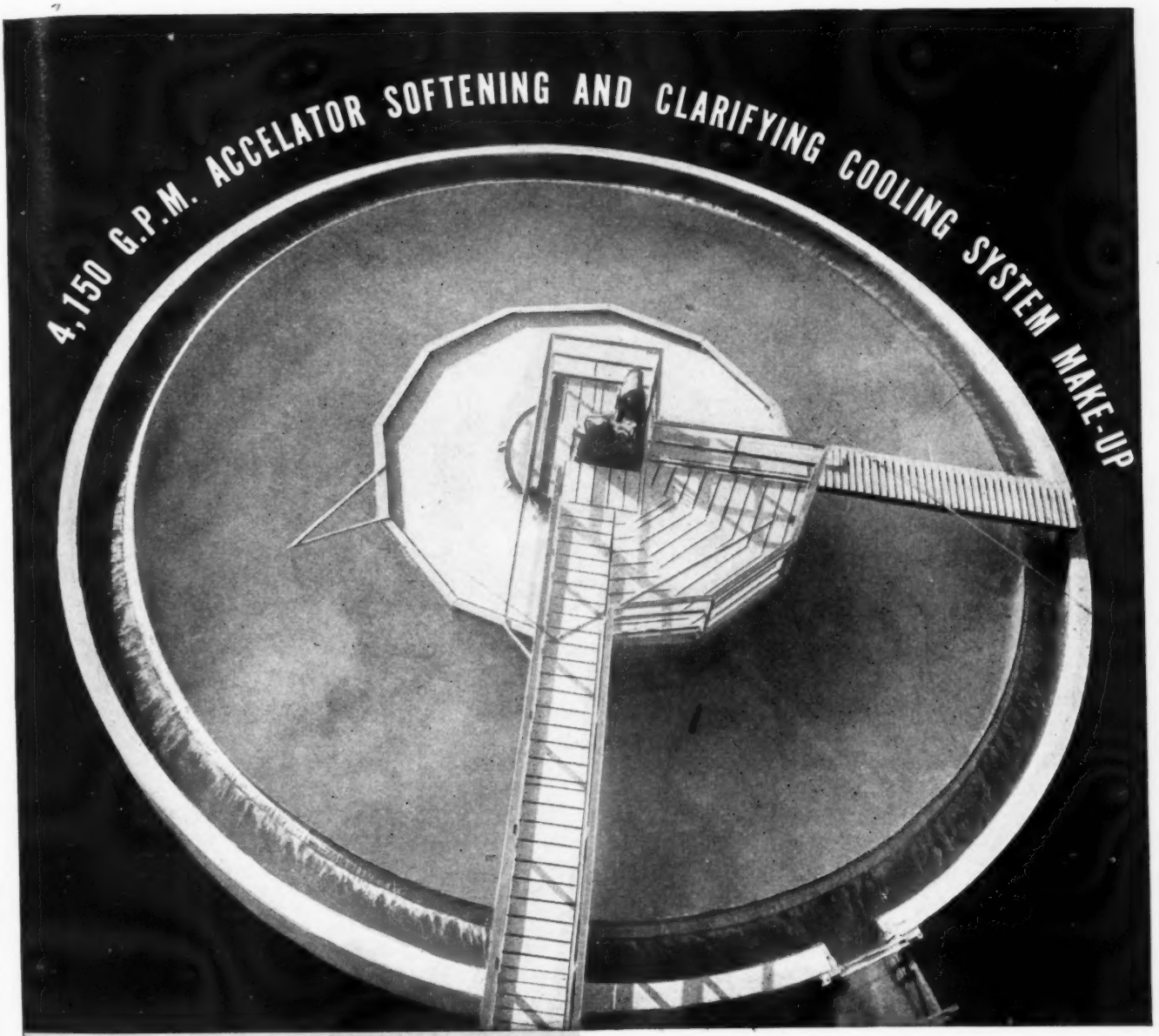
FOR STEAM TURBINES


ACIDITY is a result of oxidation.
. . . . . SINCLAIR SINTURLITE OILS are manufactured with built-in properties to resist oxidation. This means longer turbine oil life and continuous high efficiency of operation.

IN EXTENSIVE service performance SINCLAIR SINTURLITE OILS have proved their stability and resistance to formation of deposits. They fully meet requirements of steam turbine manufacturers. SINTURLITES have added serviceability as excellent oils for hydraulic and other enclosed circulating systems. Five viscosity ranges are provided to suit individual installations. Information on application of SINTURLITE OILS to your lubrication problems will be promptly furnished.

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY, 630 FIFTH AVENUE, NEW YORK 20, N. Y.



ACCELATORS

ACCELATORS are doing a lot of different things to a lot of different kinds of water . . . clarifying . . . softening . . . stabilizing . . . removing color . . . taking out iron, etc.

Results are always excellent . . . frequently remarkable.

You can't beat ACCELATORS for Performance and Economy. Would you like Bulletin 1824?

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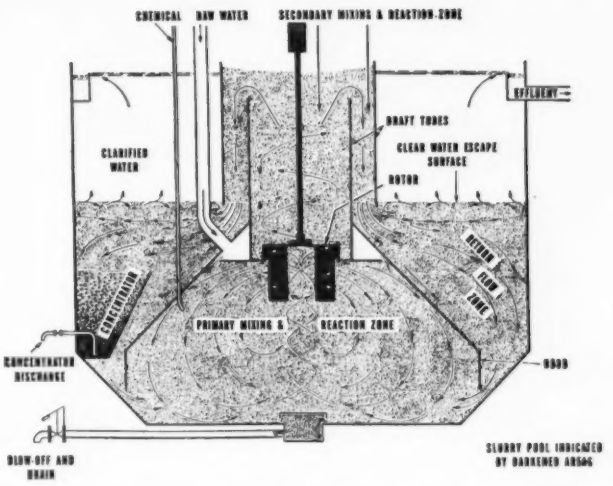
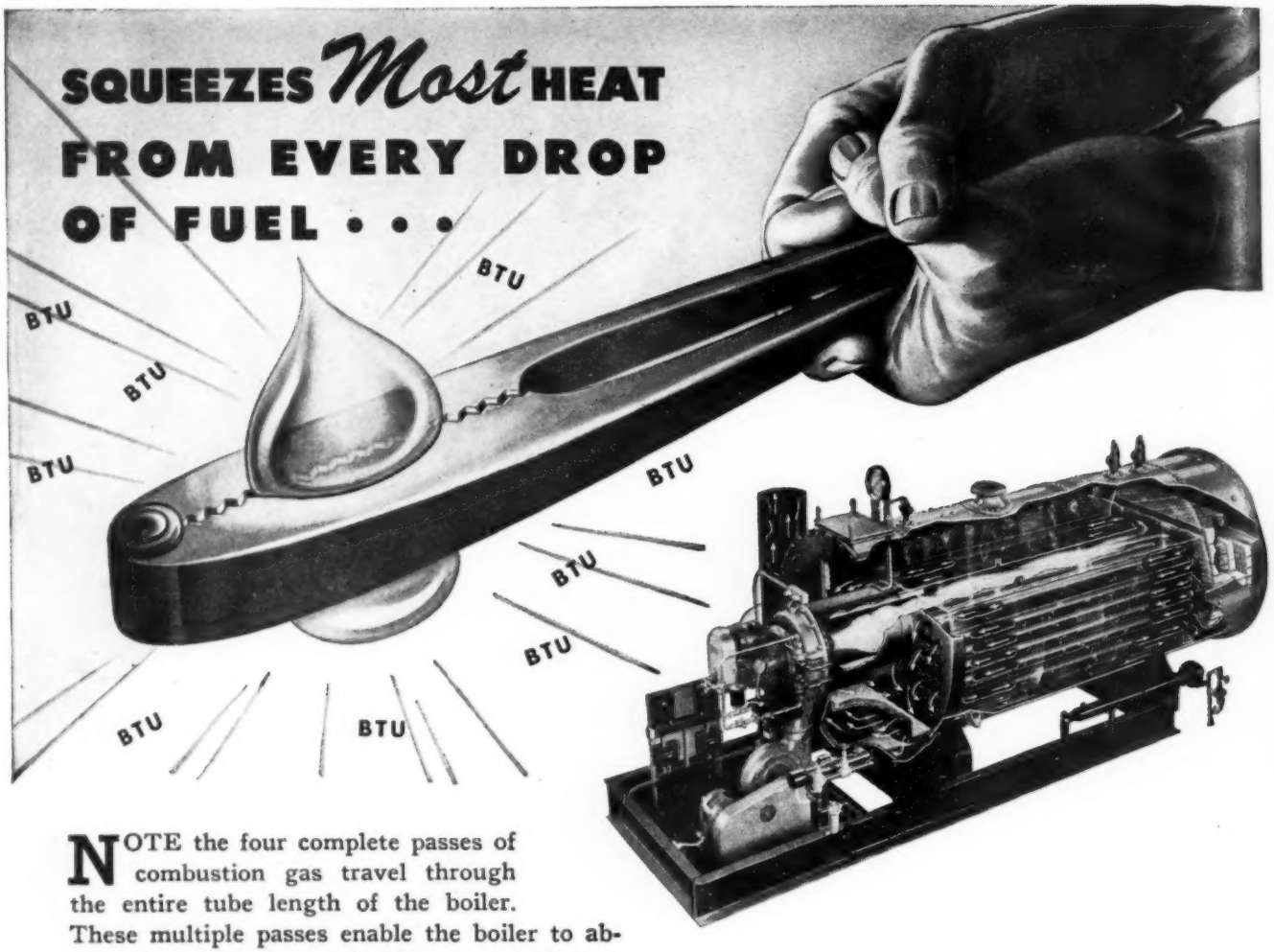


Diagrammatic Cross Section Showing Accelator Operation

All treatment steps are combined and carried out quickly in an incredibly small space. Slurry containing previously precipitated solids is recirculated through mixing and reaction and return flow zones. Chemicals are added and raw water mixed in. The sludge contact (maintained by the mechanical recirculation regardless of water throughput) insures rapid and complete chemical reactions—and the treated water rises—not through the sludge—but from the surface of the slurry pool.



NOTE the four complete passes of combustion gas travel through the entire tube length of the boiler. These multiple passes enable the boiler to absorb the greatest practicable amount of heat from the fuel burned.

The remarkable flat thermal efficiency, at low or high steam demands, of more than 80% of a Cleaver-Brooks steam generator is accomplished by the original and exclusive Cleaver-Brooks four-pass, down-draft construction of the boiler. Cleaver-Brooks steam generators offer many advantages:

- A steam plant tailored for your job. Cleaver-Brooks analyzes your load conditions, space and equipment arrangements, future growth needs, puts unit into initial operation, instructs as to operation, care and maintenance.
- Designed for utmost convenience of operator — all controls may be operated from front of boiler. A factory engineer puts unit into initial operation, and trains your employees in operation, care and maintenance.
- One source and one responsibility for the complete generator — Cleaver-Brooks factory-finished and tested — a fully "packaged" unit meeting all code requirements.
- Fast installation. No special foundation needed. Within 24 hours after arrival, your Cleaver-Brooks Steam Generator can be in operation.
- No smoke-stack required; simple roof-high vent exhausts combustion gases.
- Saves space, uses less plant area, fits into low headroom locations.
- Oil-firing eliminates smoke, ashes, clinkers, messy boiler-room conditions.
- Low operating costs; unsurpassed guarantee: — 80% thermal efficiency; 13% CO_2 gases; stack temperature not to exceed 125° F. above saturated steam temperature.
- Quick steaming for intermittent operation or fluctuating loads — through high heat transfer with Cleaver-Brooks 4-pass down-draft construction and integral oil-burner.
- Full size range is available — 22 models in sizes from 15 to 500 h.p., at steam pressures from 15 to 200 lbs. p.s.i. Write for bulletin and full information.

CLEAVER-BROOKS COMPANY, 5109 N. 33rd Street, Milwaukee 9, Wisconsin

WRITE ON YOUR BUSINESS LETTERHEAD for the Free Steam Cost-Calculator — a ready-reference slide rule showing the comparative steam costs when using oil or coal as fuel.

Cleaver-Brooks
STEAM
GENERATORS

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" BRASS CO. *Headquarters for BRASS, BRONZE, and COPPER*

Condenser Operation and Maintenance

In the 1945 Ships Manual Mr. H. M. Graham, President and Chief Engineer of the Graham Manufacturing Company of New York, discussed important factors in condenser operation and maintenance. We are taking the liberty of presenting some of Mr. Graham's suggestions for the benefit of Copper Alloy Bulletin readers, who may not have seen the article.

Starting Up a Condenser

1. Start condenser in advance of turbine operation and before any equipment that exhausts into same.
2. Check all atmospheric and vent valves to make sure that same are closed.
3. Check hotwell water level—same should be approximately half full as indicated on hotwell gauge glass. (In starting up a condenser for the first time fresh water may have to be introduced into the hotwell.)
4. Open valve in cooling water recirculating line from hotwell to air ejector inter and after condenser.
5. Start circulating water pump going after opening valves in circulating water line.
6. Start condensate pump as soon as turbine is exhausting steam into the condenser and control level of condensate.
7. Start up air ejector.

Shutting Down a Condenser

1. Steam turbine or any other source of steam to the condenser must be shut off before shutting down condenser.
2. Shut off steam to air ejector.
3. Stop condensate pump.
4. Close valve in cooling water recirculating line.
5. Shut down circulating water pump.

Maintenance Suggestions

If properly maintained, a surface condenser will generally give satisfactory service. In the event of trouble, however, the following procedures may be found helpful.

1. Fouling of the Condenser Tubes: This is evidenced by a loss of vacuum; and the manhole covers on the water boxes, or possibly the water boxes themselves, should be removed and the tubes thoroughly cleaned.

2. A Leaky Tube: This trouble is generally indicated by constant flooding of the hotwell, and when the circulating water is salt, such leakage will show up on the salinity indicator as having contaminated the condensate.

To correct this difficulty it is first necessary to determine exactly where the leak is located. This can best be done by flooding the condenser up to the exhaust inlet connection. If the condenser is suspended from the turbine, it may be desirable to block up the condenser to eliminate this unusual weight from the turbine exhaust.

Once the condenser is flooded, water will run out of the tubes if they are ruptured within the condenser; and secondly, if the joint between the tube and the tube sheet is not tight, water will run out at this point. If the latter is the difficulty, tubes should be re-expanded, if they were originally put in by that method.

If the tubes were packed, the packing should be adjusted or possibly replaced until the leak is stopped. Leaky tubes should either be replaced or plugged up.

3. Turbine Gland Not Sealing Properly: This difficulty is corrected by adjusting the sealing pressure, or in extreme cases, examining the gland seals themselves to see if they have worn excessively.

4. General Air Leakage: The condensing system is designed to handle whatever air enters the condenser with the exhaust steam from the turbine, plus a normal amount of leakage from the turbine and other parts of the system under vacuum. General air leakage around valves, valve stems, gauge glasses, float control apparatus, flange gaskets, should be checked thoroughly in the event of any difficulties indicating loss of vacuum. It should be borne in mind that the vacuum extends back into the turbine and sometimes into the extraction heater at periods of light load in the event that such a heater is incorporated in the system. Air leakage should be promptly corrected as it increases the corrosion rate of the condenser tubes.

5. Insufficient Condensing Water: The quantity of circulating water should equal the quantity for which the condenser is rated, especially with warm, condensing water.

Formula for determining approximate G.P.M. circulated:

$$\text{G.P.M.} = \frac{(\text{lbs. steam condensed/hr}) \times 950}{(\text{Discharge Temp. °F.} - \text{Inlet Temp. °F.}) \times 500}$$

This may be determined by measuring the temperature rise in the circulating water passing through the condenser. At full shaft horse power the difference between the outlet condensing water temperature and the inlet temperature generally should not exceed 10°F. If the condensing water, in passing through the condenser, is heated more than this, the quantity of water is too low and the circulating water pump and piping should be checked to determine the cause of the deficiency in the condensing water system. Any obstruction such as foreign matter in the condenser tubes, or, should such refuse cover the strainer plate, there would be an increase in the pumping head on the circulating water pump and thus cut down the quantity of circulating water even though the pump may be in perfect operating condition.

Mr. Graham also suggests that the best way to avoid forced shutdown is periodic inspection and subsequent maintenance of all parts giving any suspicion of failure or otherwise indicating the need for repair.

Every seven days: Blow out air ejector strainer while units are in operation.

Every 30 days: Inspect all pump glands for leakage. If leakage is evident glands should be tightened to prevent air leakage and subsequent vacuum depreciation.

Every six months: Inspect and replace if necessary, zinc plates in the condenser water boxes.

Every 12 months: Inspect tubes of condensers for scale deposits and possible tube deterioration. Clean or replace tubes if this inspection warrants.

Thus all trouble should be avoided, and over a period of a year or more economies will certainly accrue from this system of applying "preventive medicine" rather than waiting for difficulty to occur.

Corrosion Resistant Alloys Available

Power plant operators are preparing for the future demands of industry and consumers by trying out improved condenser tube alloys to obtain longer life, prevent costly breakdowns and reduce maintenance expense.

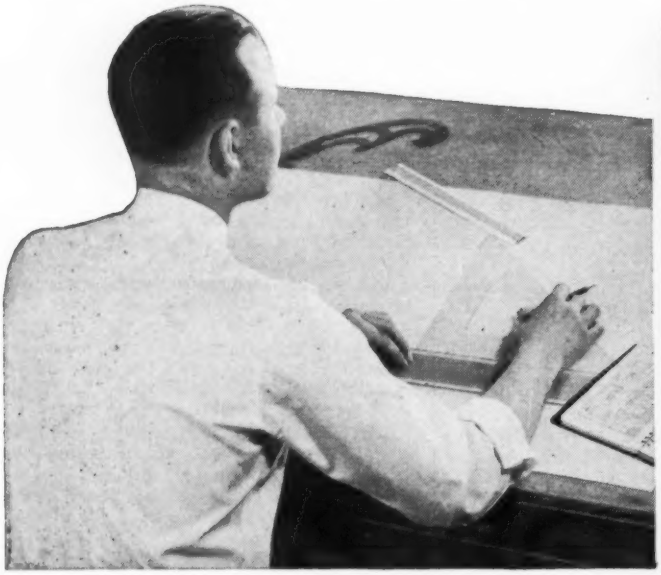
Much progress has been made in corrosion research, as well as in field and service tests to determine the causes of condenser tube corrosion, and the influence of various factors on the corrosion rate of different alloys. Bridgeport has maintained a consistent program along these lines and has accumulated much valuable data over a period of many years. A great deal of this information is available through our Technical Service Department to operators.

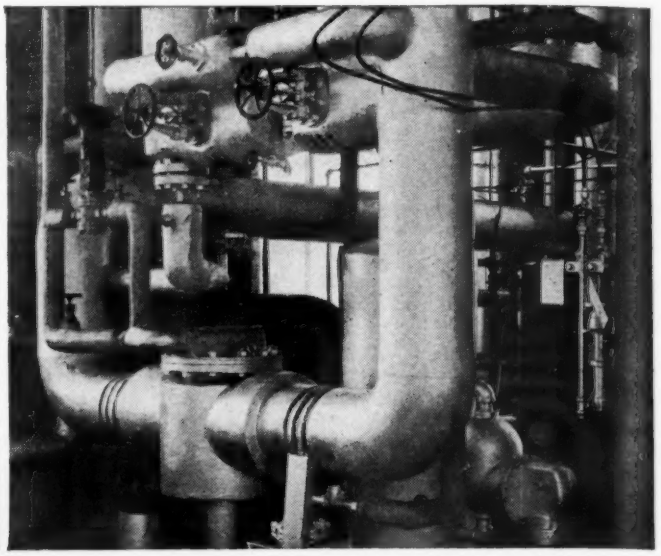
A number of corrosion resistant condenser tube alloys are available which, if used under conditions for which they are best suited, will give longest service life and greatest economy. Arrangements may be made through our Technical Service Department to try out test lots of these alloys in order to determine which is best for the conditions involved. The properties of these alloys and their applications are described in Bridgeport's 112-page Condenser Tube Manual, full of practical information, specifications, corrosion research data and other valuable facts. A request on Company stationery will bring your copy promptly.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • *ESTABLISHED 1865*

The properties you need in Power Piping





High pressure reducing valve station and desuperheater in a large paper mill. NATIONAL Seamless was used for safety and workability.

Here's what National Seamless offers...

STRENGTH. Ultimate strength from 48,000 p.s.i. to 60,000 p.s.i. or more as required.

DUCTILITY. Meets requirements for flanging, bending, expanding, coiling and similar purposes.

CREEP STRENGTH. Available in various grades of steel to assure a minimum of creep regardless of the temperatures encountered.

CORROSION RESISTANCE. Various grades of steel from plain carbon to U·S·S Stainless according to service requirements.

HEAT RESISTANCE. Various heat-resisting alloys for higher temperatures and special conditions.

WELDABILITY. Readily weldable with the proper types of welding rods.

UNIFORM WALL STRENGTH. The piercing of a solid billet of steel to form seamless pipe stands alone among all processes of pipe making as the one method that absolutely removes all uncertainty regarding uniform wall strength. There is no weld in seamless to provide a starting point for failure.

Corrugated pipe bend made from a section of ½" wall thickness. Shows high ductility of NATIONAL Seamless.

SIZES AND WALLS. Sizes range from ⅛ inch to 24 inches—with wide choice of wall thicknesses.

SPECIFICATIONS. Pipe made to Standard Specifications.

SAFETY. The above are some of the more important qualities of NATIONAL Power Piping, which help to provide a safe and sound installation.

Now that material is again available for civilian use, plan to order NATIONAL Seamless Pipe for your requirements—the pipe made by the largest producer of steel tubular products in the world.

EVERY SUNDAY EVENING, United States Steel presents *The Theatre Guild on the Air.* American Broadcasting Company coast-to-coast network. Consult your newspaper for time and station.

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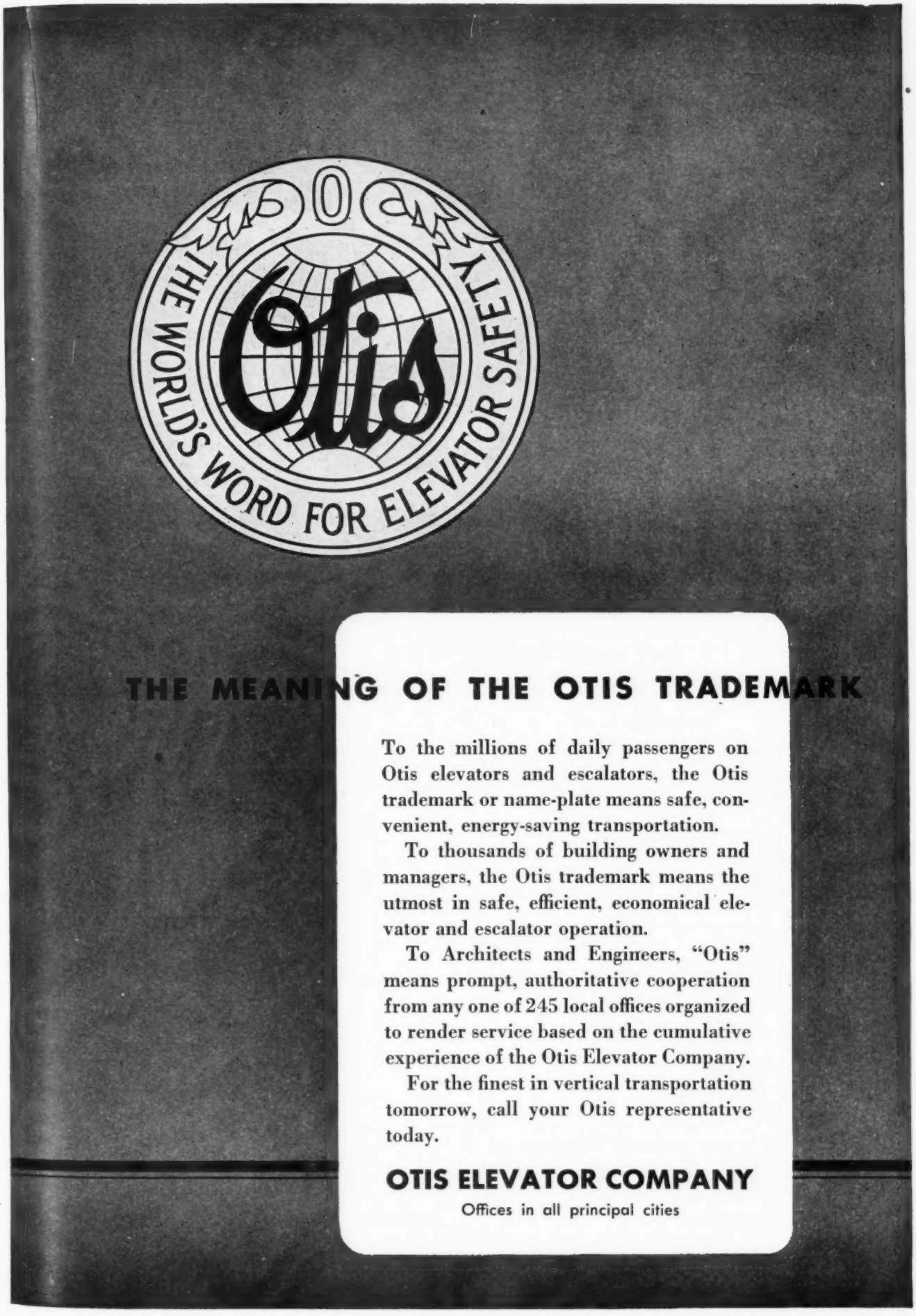


THE MEANING OF THE OTIS TRADEMARK

To the millions of daily passengers on Otis elevators and escalators, the Otis trademark or name-plate means safe, convenient, energy-saving transportation.

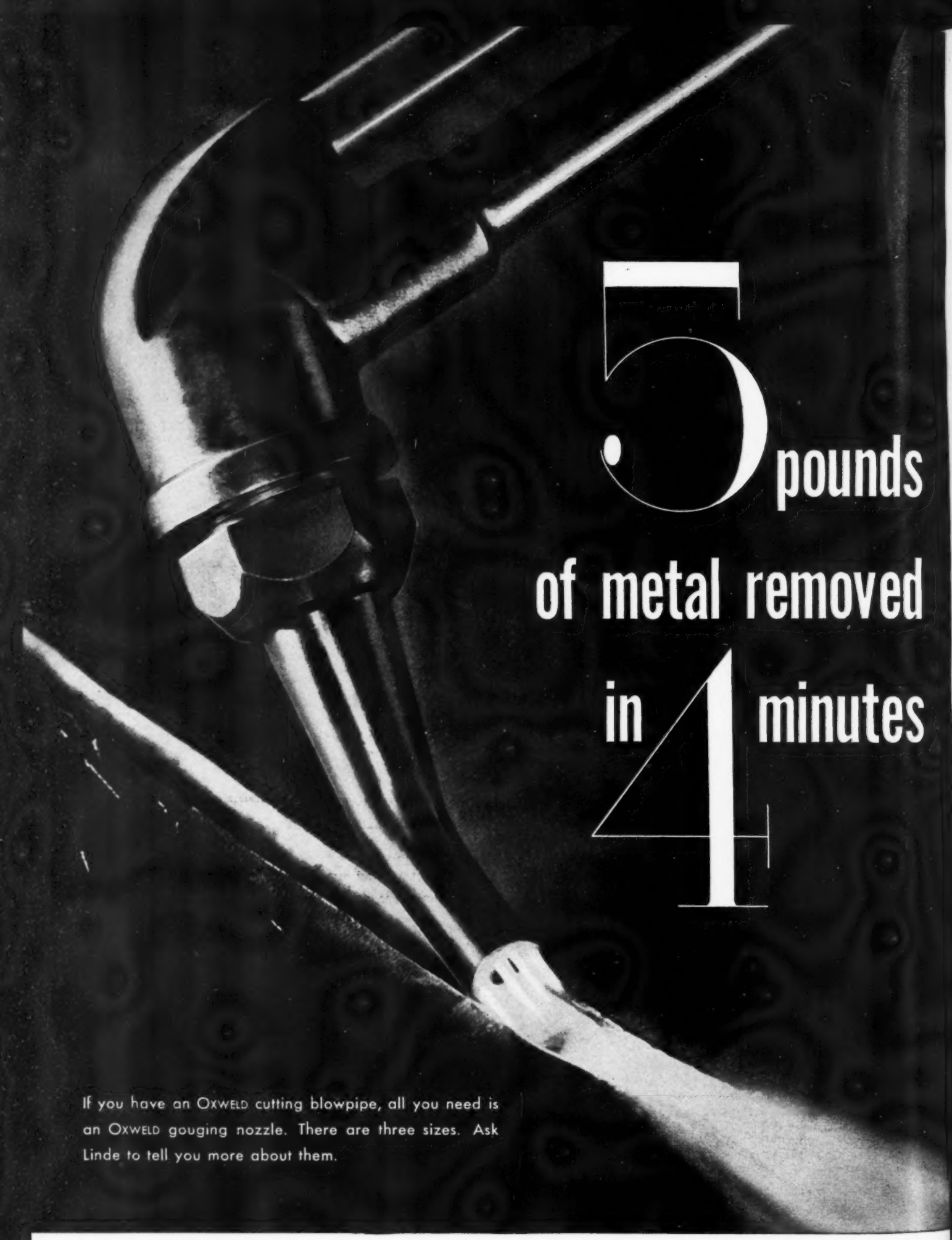
To thousands of building owners and managers, the Otis trademark means the utmost in safe, efficient, economical elevator and escalator operation.

To Architects and Engineers, "Otis" means prompt, authoritative cooperation from any one of 245 local offices organized to render service based on the cumulative experience of the Otis Elevator Company.

For the finest in vertical transportation tomorrow, call your Otis representative today.

OTIS ELEVATOR COMPANY

Offices in all principal cities

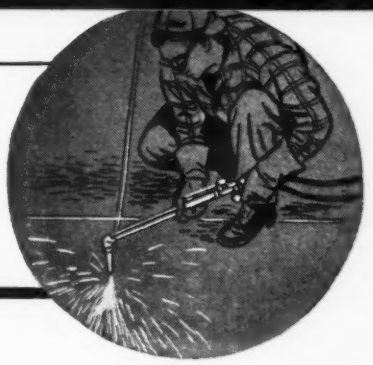


If you have an OXWELD cutting blowpipe, all you need is an OXWELD gouging nozzle. There are three sizes. Ask Linde to tell you more about them.

Visit Linde's Exhibit at the National Metal Exposition, Cleveland, Ohio, Feb. 4-8. Area G621.

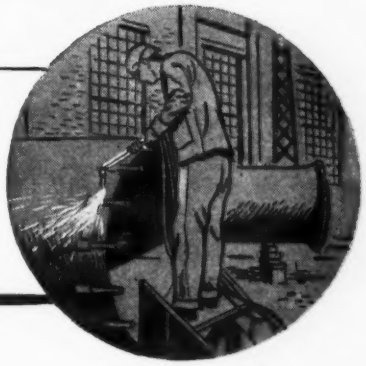
These are the advantages of Flame-Gouging

1 It is a faster way to groove weld joints to receive backing-up welds . . . 36 to 48 in. per min. (gouging time).



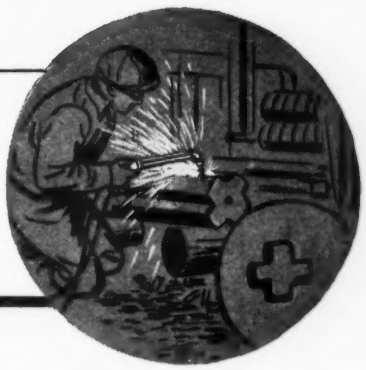
The bottom shell on a T-2 tanker is prepared for welding at the rate of 16 in. per min. (hourly average).

2 It is a quick and easy way to remove temporary or defective welds.



The operator is removing studs that were used to clamp a testing head to a pipe section.

3 Parts shaped by flame-gouging frequently require no machining before use.



This shaft er 3 in. wide a 12 in. long, quickl grooved to a clutch.

4 It is a fast way to open up cracks in castings for welded repair or to modify forgings and castings.

This 18½ ft. crack in a cone crusher was gouged out to sound metal in only 4¾ hours.

5 It is one of the quickest, most economical ways to prepare plate edges for welding.

Two plate edges that have been tacked together are U-grooved simultaneously.

The word "Oxweld" is a trade-mark.

THE LINDE AIR PRODUCTS COMPANY

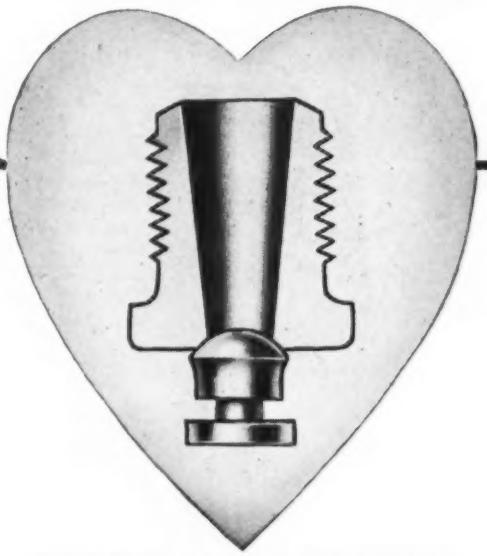
Unit of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

New HI-CAP Orifice Gives STRONG Traps

UP TO 25% *greater* CAPACITY



THE heart of the improved STRONG Trap is this HI-CAP* Valve and Seat assembly. New, scientifically designed orifice throat gives up to 25% greater capacity, avoids turbulence and minimizes choking caused by flash steam. *An important part of STRONG service is continued attention to parts for traps in service. HI-CAP parts are available for your present 70 series traps.*

*HI-CAP—Registered trade mark

STRONG 2-IN-1 TRAPS

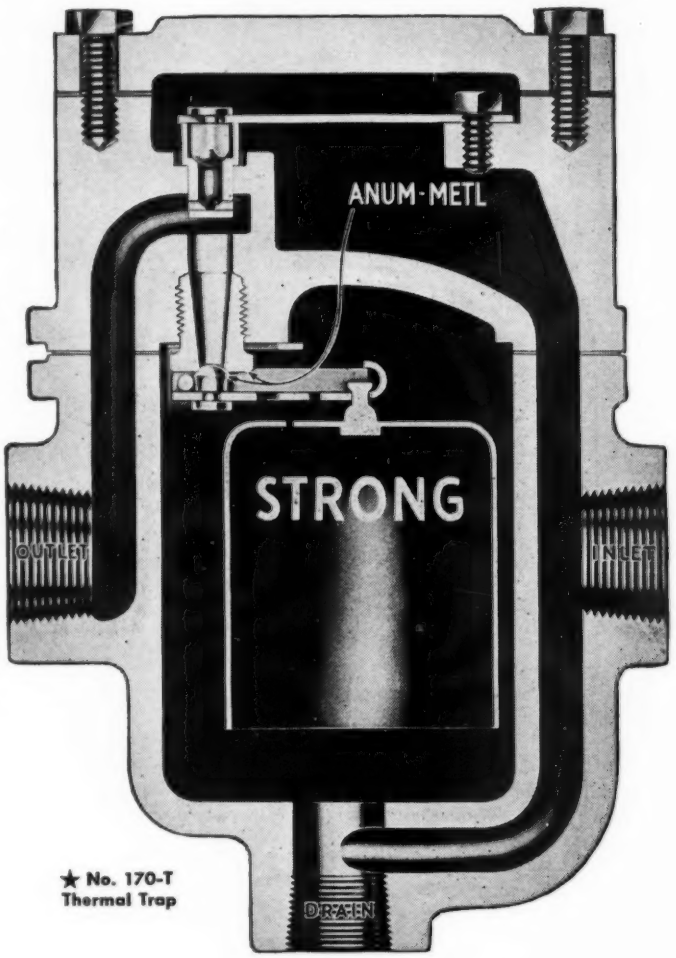
THE STRONG "T" Traps combine in one unit the economies of inverted bucket traps with air removal capacity of the thermal traps. They are particularly suited to equipment or processes requiring quick air and condensate removal for rapid heating up.

The "T" type is included in the new line of HI-CAP straight-through traps in sizes from 1/2" to 1-1/4". With the new STRONG HI-CAP Traps . . . both standard and thermal . . . you get:

- HI-CAP orifice
- Screwed in ANUM-METL valve and seat
- Straight-through or elbow piping
- All stainless steel trim

Write for New Bulletin on HI-CAP Traps

STRONG, CARLISLE & HAMMOND CO.
Over 40 Years of Steam Specialties
CLEVELAND 13, OHIO



★ No. 170-T Thermal Trap

NEW lever design gives quick, full opening without dribbling.

NEW renewable seat permits easy servicing.

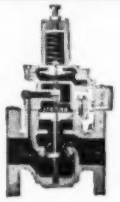
NEW inlet-outlet location places trap below inlet pipe at all times.

REG. TRADE MARK

OTHER ANUM-METL Reg Trade Mark

STRONG

STEAM SPECIALTIES



Reducing Valves

No. 80—Series Trap

HI-CAP Inverted Bucket Traps

75% ARE "Flexitallic" GASKET EQUIPPED!

REG. U. S. PAT. OFFICE

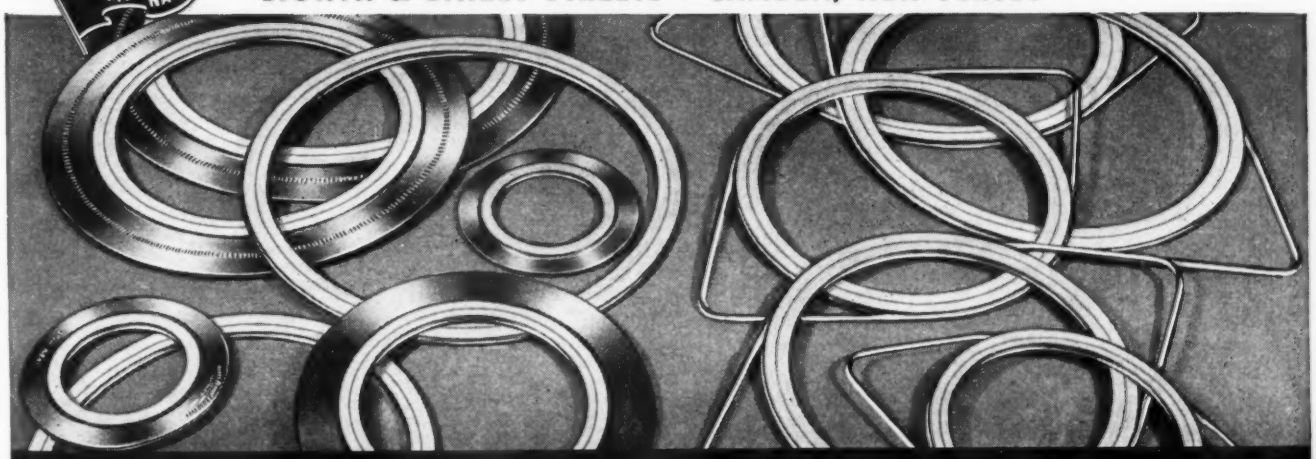
With the end of the war, probably 75% of all combat vessels and an extremely high percentage of maritime craft were equipped with Flexitallic—the original—Spiral-Wound Gaskets. Figures such as these speak plainer than words in emphasizing Flexitallic superiority and industry-wide engineering acceptance.

Flexitallic Gaskets will not let you down when the going is rough. Their resilient construction compensates for even the most violent pressure surges, temperature changes, and vibration stresses. They'll stand the gaff—and come back asking for more. In addition, they're easier to install, minimize laborious hand finishing of seating surfaces and eliminate complicated gauging of bolting tension. Write for catalog.

ARMY E NAVY

FLEXITALLIC GASKET COMPANY

EIGHTH & BAILEY STREETS • CAMDEN, NEW JERSEY



ORIGINATORS OF THE SPIRAL-WOUND GASKET . . . SPECIALISTS IN SPIRAL-WOUND GASKETS EXCLUSIVELY FOR OVER A THIRD OF A CENTURY

WORTHINGTON

Completely Engineered "Package Type" Power Plants ...with Steam Turbine Generator, Boiler AND All Auxiliaries

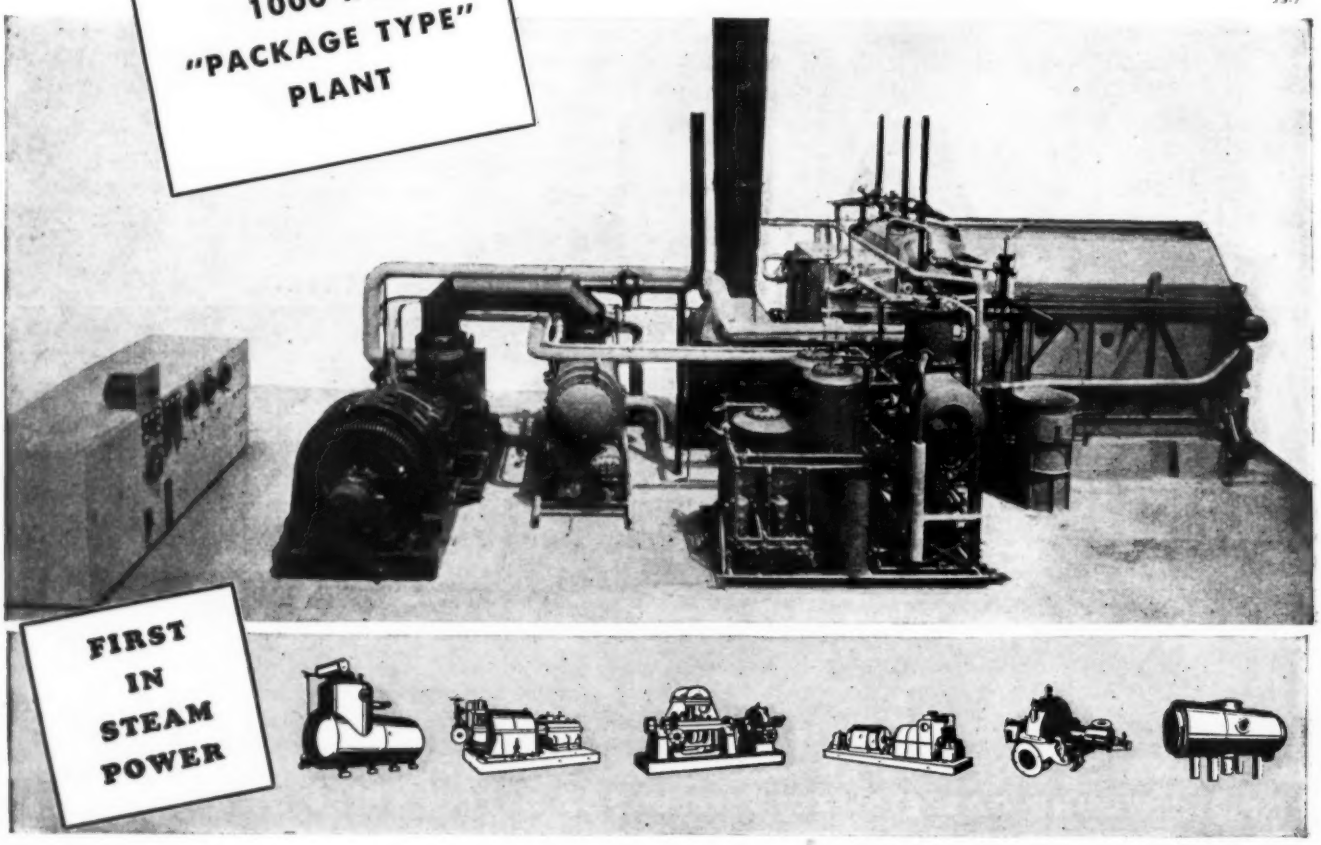
Worthington "Package Type" Power Plants designed by Peter F. Loftus, Consulting Engineer, Pittsburgh, Pa.—are now available in sizes:

500 KW Capacity • 1000 KW Capacity • 2000 KW Capacity

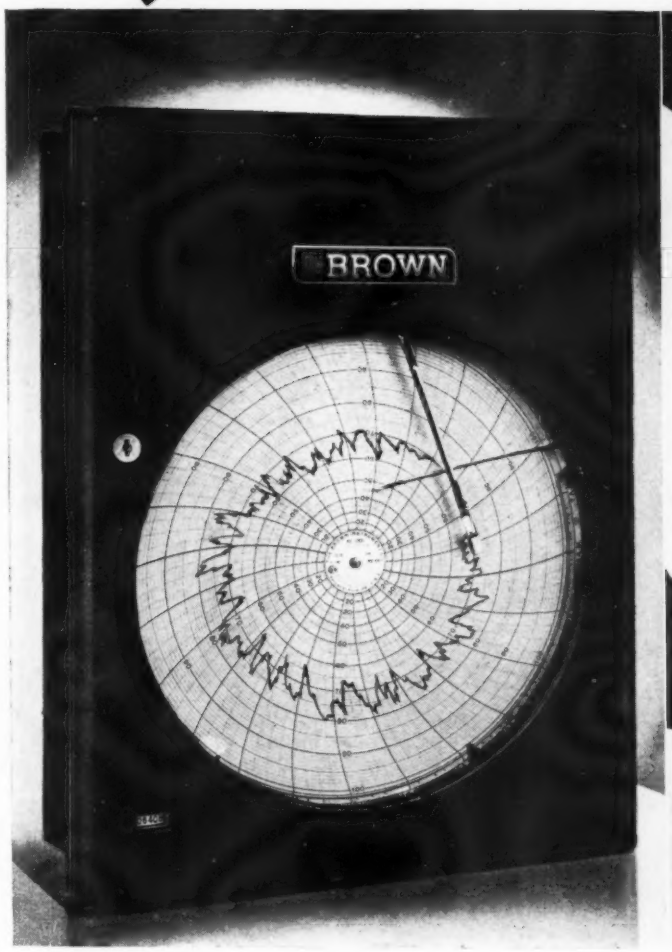
Write for bulletin WP-1099-B-50 which gives all the facts about Worthington "Package Type" Power Plants, and proves *there's more worth in Worthington.*

Worthington Pump and Machinery Corporation, Harrison, N. J.

WORTHINGTON



INTERCHANGEABLE



INTERRELATED RANGE TUBES

THE easy range-changing feature of the Brown Electric Flow Meter has proved to be of great advantage to users.

If the original flow estimate is found in error (as it is in many cases) or if the average rate of flow changes (as it frequently does), the orifice need not be disturbed, nor another meter body installed to obtain the required range. With the Brown Electric Flow Meter all that is required is to install a *new range tube* of proper size in the meter body and use a chart of matched range in the recorder.

Range tubes make range changing easy—quick—inexpensive—no shutdowns or loss of records.

Seven interchangeable range tubes make it possible to get a four to one change in meter capacity in steps of roughly 25 per cent.

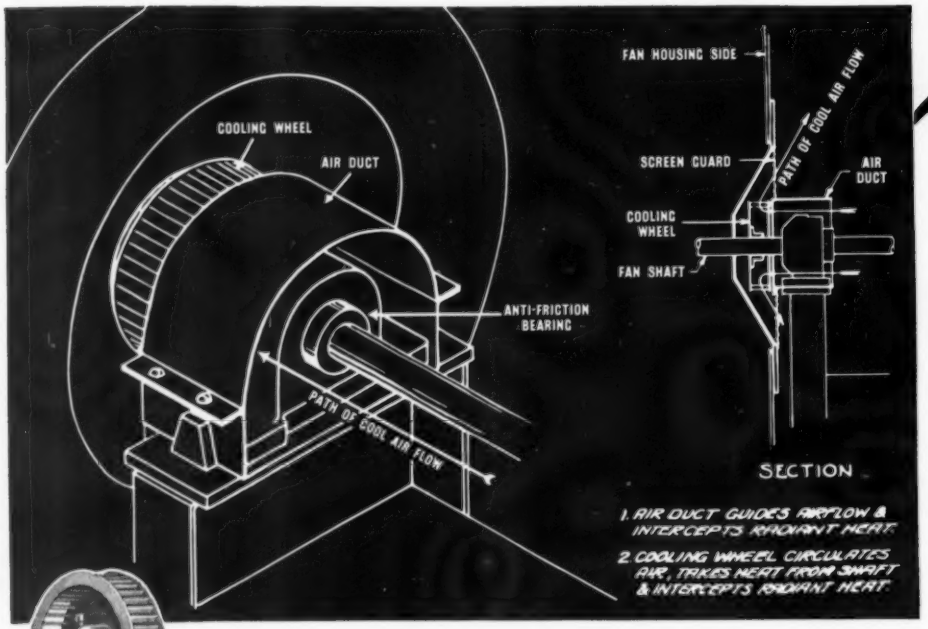
Other range tubes (25, 50, 100 and 200 inches of water differential capacity), and special range tubes for liquid level applications, are also available.

When ordered a valve manifold is supplied as an extra for all flow applications and for liquid level applications when required. Equipped with two shut-off valves and equalizing valves of forged steel with stainless steel trim.

Write for Catalog 2008, THE BROWN INSTRUMENT COMPANY; a division of Minneapolis-Honeywell Regulator Company, 4490 Wayne Avenue, Philadelphia 44, Pa. Offices in all principal cities. Toronto, Canada; London, England; Stockholm, Sweden; Amsterdam, Holland.

BROWN FLOW METERS
. . . MINNEAPOLIS - HONEYWELL CONTROL SYSTEMS . . .

How to Simplify a Hot Fan Installation



1. Lower First Cost

2. Reduced Maintenance

3. Shutdowns Avoided

This small wheel located as shown above "does the trick"

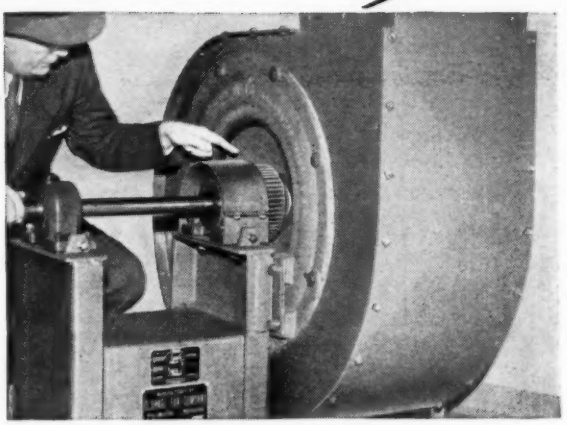
When you need fans for handling air or other gases at high temperatures, some provision MUST BE MADE for cooling the lubricant in the fan bearings. Usually, under these circumstances, the fan bearings are water-cooled.

But water-cooled bearings present all kinds of hazards! Leaks may develop, and water gets into the bearing oil — or someone forgets to turn on the water when the fan is started — or the water pipes plug up — or water in the pipes and bearing cases freezes, and breakage results.

That's why Clarage engineers developed the simple arrangement shown above. The small cooling wheel induces a continuous flow of cool air over the anti-friction bearings. It is effective and trouble-free.

No expensive water-cooled bearings or pipe lines required! You save handsomely in first cost and maintenance, and you eliminate entirely the chance of shutdowns due to someone's negligence.

O.K. UP TO 700° F. — *Clarage fans with air-cooled anti-friction bearings are recommended for jobs where temperatures range from 200° F. to 700° F. If you're interested in economy and more dependable operation, write us today.*



There's nothing experimental or untried about Clarage *air-cooled bearings.* We have been recommending them for years — hundreds of successful installations. Fan above is handling core oven gases in a large foundry.

COMPLETE AIR CONDITIONING
COOLING • VENTILATION • MECHANICAL
DRAFT • HEATING • FANS FOR INDUSTRIAL NEEDS

CLARAGE
FAN COMPANY
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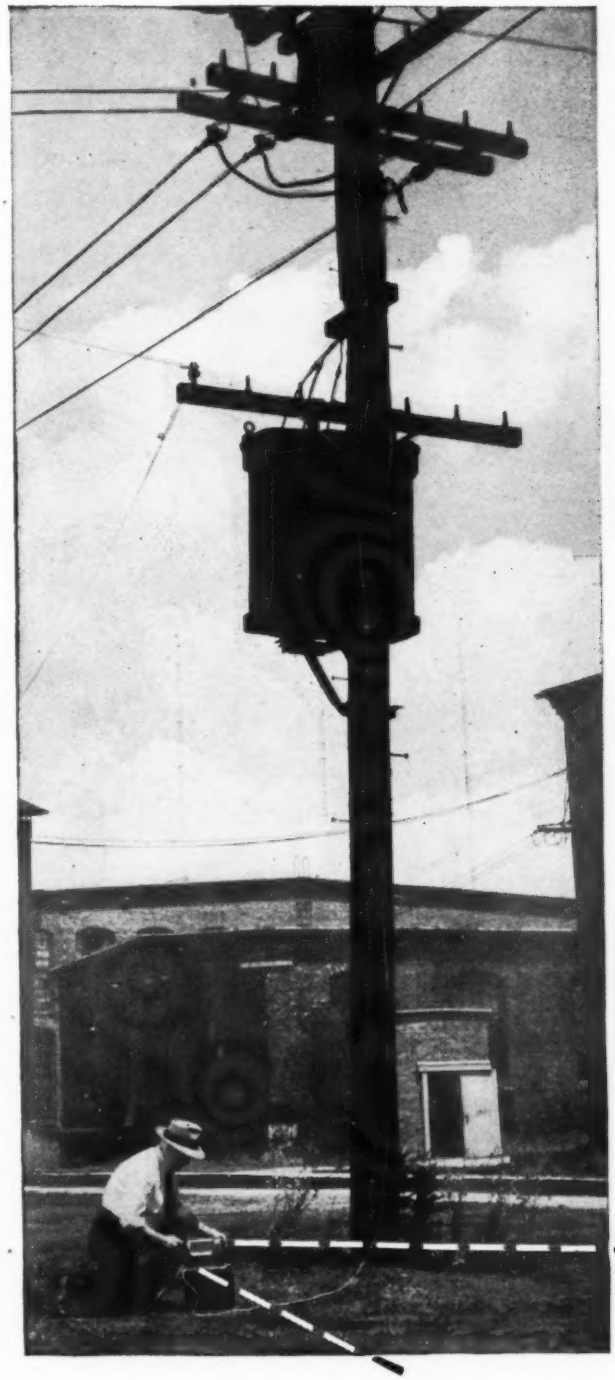
APPLICATION ENGINEERING OFFICES IN ALL PRINCIPAL CITIES



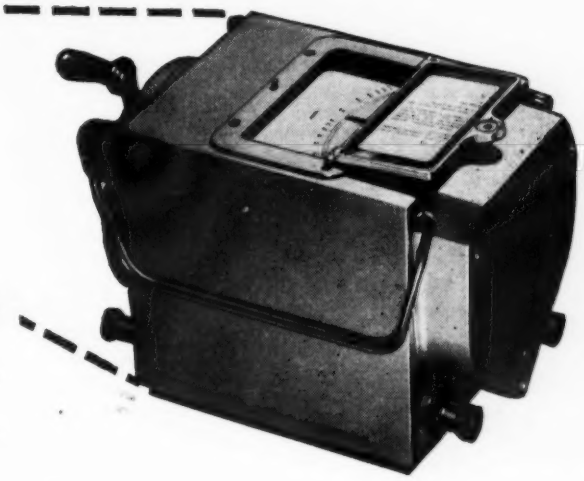
Are you getting protection from your ground connections?

• Ground connections that are improperly installed or have dried out; contacts that have become corroded and loose; exposed metal parts that may become "live" when they should be grounded—all of these can cause trouble when lightning strikes or fault currents develop—can cause injury or death to personnel and material damage to operating equipment.

Know the condition of all your man-made grounds through the periodic use of a "Megger" Ground Tester. These well-known and widely-adopted instruments measure resistance to earth of ground connections, quickly, easily and accurately. Since 1927 they have come into extensive use by power companies, railroads, industrial plants, telephone and telegraph companies everywhere . . . Supplied in both "Megger" and "Meg" types, in various ranges from 0-3 to 0-30,000 ohms.

Order now for your Spring ground testing program.

For a full description of the "Megger" Ground Testers, including the principle of operation, write for Catalog P.



Some important and valuable features of the "MEGGER"* GROUND TESTER

1. *Has its own hand generator; requires no batteries or other external power supply.*
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4. *Only one set of connections.*
5. *No adjustments or "balancing."*
6. *Unaffected by the exact resistance of the reference grounds.*
7. *Unaffected by stray current in the earth either a-c or d-c, or by polarization or electrolysis.*
8. *Covers a wide range of resistance —0-3 up to 0-30,000 ohms.*
9. *Self-contained, rugged and portable.*
10. *Represents only a small fraction of the cost of adequate grounding protection.*

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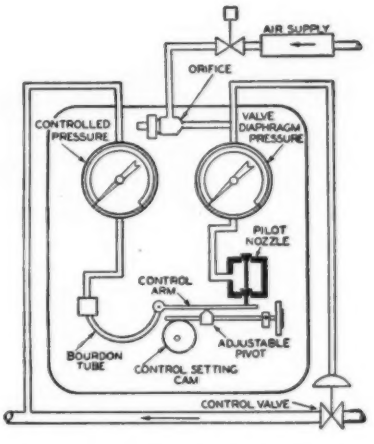
Use Masoneilan Pressure Controllers

Want accurate instrument control of pressures in processes where other less efficient methods are now used? Then install Masoneilan No. 2500 Pressure Controllers.

These simple, accurate and economical controllers are especially designed to give *low cost* instrument control of a wide variety of applications such as service on primary or auxiliary steam lines, evaporators, turbine or bleeder make-up and pump discharge pressure control. Note these features — external knob for adjusting micrometer control point setting, throttling range from 3 to 50%, easily convertible, from direct to reverse acting or vice versa.

Why put up with less efficient methods when you can get *low cost* accurate instrument control with Masoneilan No. 2500 Pressure Controllers. Write for bulletin, today.



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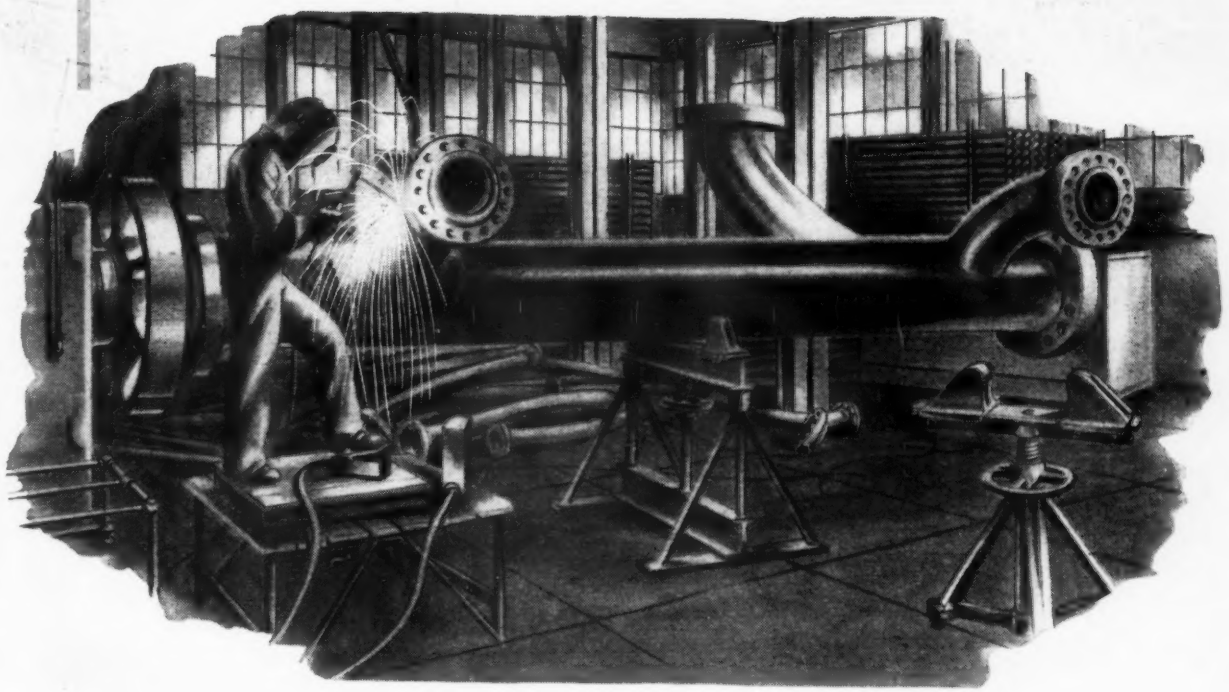
SHOP WELDING of Pressure Piping has Important Advantages



Welding of pressure piping in the shop of a qualified pipe fabricator has many advantages which are difficult to duplicate in the field.

The great volume of pressure welding done in the plant of the fabricator gives *continuous* employment to large numbers of qualified welders—this day-after-day welding means that the hand never loses its skill. The welders are provided with a wide variety of work rotating fixtures for position welding under the most favorable conditions for both quality and production. Other facilities (usually superior in the shop) that have a direct bearing on the quality of welded piping include equipment for accurate layout, correcting alignment, stress relieving, cleaning and testing.

In the fabricating plant, it is much easier to exercise close and continuous supervision over all welders . . . to make certain that approved procedures are exactly followed in every detail.

Better welding is just one of the reasons why prefabricated piping by qualified fabricators is better piping.

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DEVOTED TO THE TECHNICAL AND ECONOMIC PROBLEMS IN PIPING

G-4

Can't Knock Out Permanently Insulated ROCKBESTOS A.V.C.

You may not be looking for trouble . . . but it's on its way if you are still operating overworked circuits that were nearing collapse before the war . . . and if you still have war-installed control, power and lighting wiring in hot spots that wasn't built to take the beating of high ambient temperatures and conductor-heating overloads.

Why take chances if that's your situation? Check up on the trouble-spots and plan to eliminate future production tie-ups, shut downs, and expensive emergency maintenance by re-wiring with Rockbestos A.V.C. Power Cable, Motor Lead Cable, Control Cable and Boiler Room Wire. Their *impregnated asbestos* insulation and heavy *asbestos* braid takes operating temperatures up to 230° F., the heat of overloads, and vibration because it retains flexibility and won't bake brittle or crack. It won't bloom or rot when exposed to oil, grease or corrosive fumes . . . it won't burn because asbestos is fireproof . . . and it can be installed in conduit because specially compounded impregnants give it high moisture resistance.

Don't delay necessary wire-failure prevention . . . investigate your needs for the Rockbestos-designed National Electrical Code types illustrated and others in our line of 125 different standard wires, cables and cords. Write or phone for recommendations to the nearest district office or:

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125 different wires, cables and cords developed for severe operating conditions by Rockbestos.

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ROCKBESTOS A.V.C. 600 VOLT POWER CABLE (Nat. Elec. Code, Type AVA—max. operating temp. 110°C.)

Sizes No. 18 AWG to 1,000,000 CM insulated with two walls of impregnated felted asbestos, varnished cambric and asbestos braid. Other constructions for service voltages to 5000.

You can use Rockbestos A.V.C. Power Cable for hot-spot wiring, in conduit or open, around boiler rooms, steam lines, furnaces, etc., and for power leads or heat-exposed electrical equipment as it withstands high temperatures and has ample moisture resistance. Use similarly insulated Rockbestos A.V.C. Motor Lead Cable for motor leads and coil connections.

FOR LIGHTING CIRCUITS

ROCKBESTOS A.V.C. 600 VOLT BOILER ROOM WIRE (Nat. Elec. Code, Type AVA—max. operating temp. 110°C.)

Sizes No. 18 to 8 AWG insulated with varnished cambric, impregnated felted asbestos and asbestos braid. Sizes 6 to 4/0 have another wall of impregnated asbestos next to the conductor.

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A.V.C. construction is ideal. Its permanent insulation will not bake brittle, crack, rot, flow or swell.

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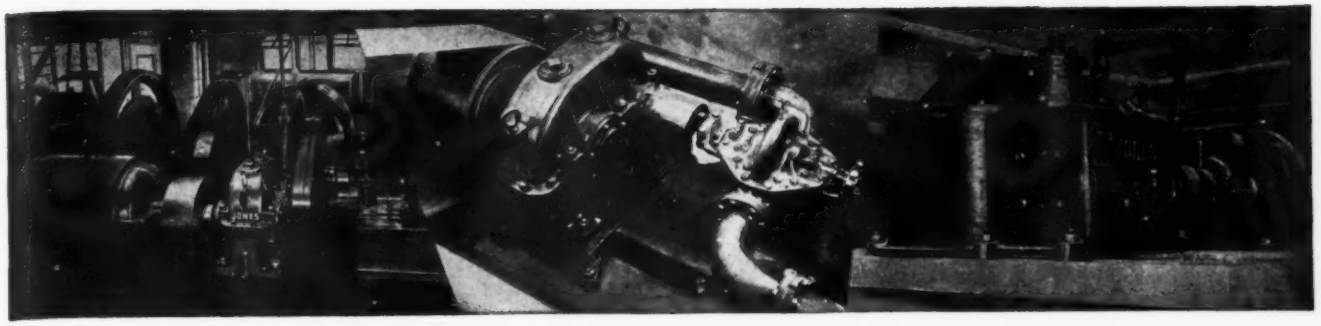
ROCKBESTOS A.V.C. 600 VOLT CONTROL CABLE

In one to 19 conductors with individuals insulated like Power Cable, cotton braid covered, and cabled with an asbestos braid overall. Standard strandings AWG No. 12—19/#25 and No. 9—19/#22. Other strandings on order.

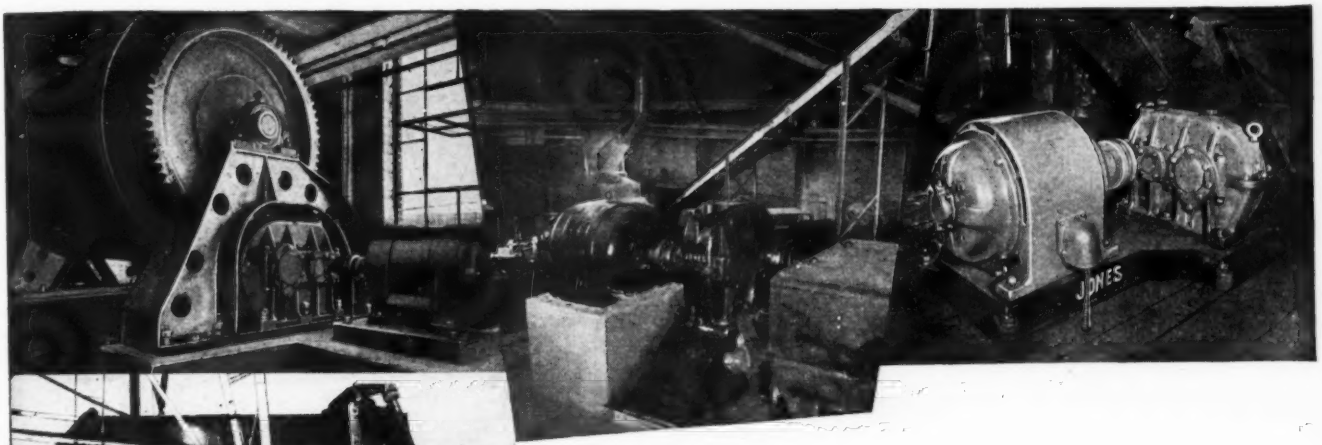
Designed for use in equipment requiring a multi-conductor control cable capable of withstanding high temperatures, this cable is widely used in the control systems of electric cranes and other equipment used in steel mills. The insulation is unaffected by heat, corrosive fumes, oil or grease and has ample moisture resistance.

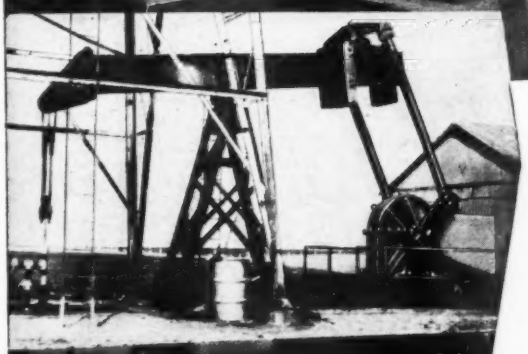
ANOTHER NEW ROCKBESTOS HIGH TEMPERATURE CONSTRUCTION!

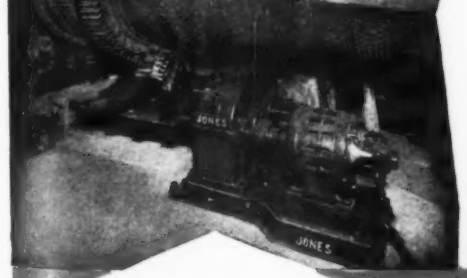
War-developed Rockbestos High-Temperature Wire — *with a maximum operating temperature of 400° F.* — designed for jet propelled plane applications and circuits to hot-wing de-icers, fire detectors and extinguishers, and air conditioning and heating units where baking temperatures destroy ordinary insulation. Under continuous operation at rated temperature it retains its original dielectric strength and inherent resistance to heat and flame, and *progressively improves* in its resistance to moisture and abrasion. It is now available for these and other severe applications. Write for complete information and samples.

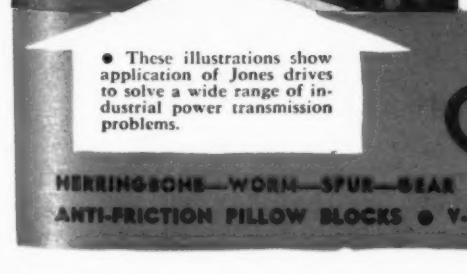


JONES DRIVES FOR INDUSTRY









• These illustrations show application of Jones drives to solve a wide range of industrial power transmission problems.

★ For many years the W. A. Jones Foundry & Machine Company has been called upon as a consultant, to help solve a great variety of difficult drives involving the use of speed reducers, gears and other transmission machinery. In many cases these installations have called for the development of special equipment, designed and built to suit the specific requirements of the project.

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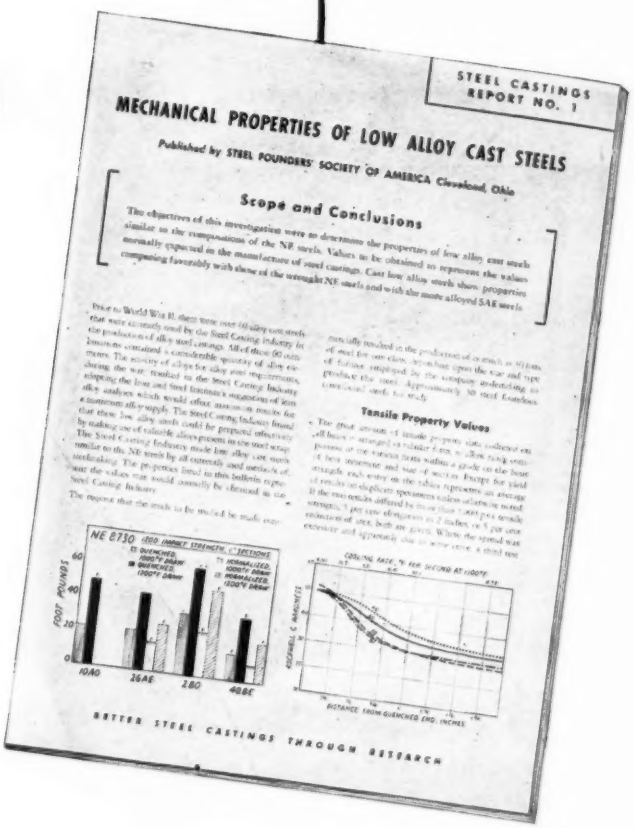
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For every conceivable type of Industrial Drive, there is a correct type of Philadelphia Speed Reducer—and by choosing Philadelphia Reducers, you not only secure *Quality Products,* but you place the responsibility for their construction and operation with *one manufacturer* (a point worthy of serious consideration).

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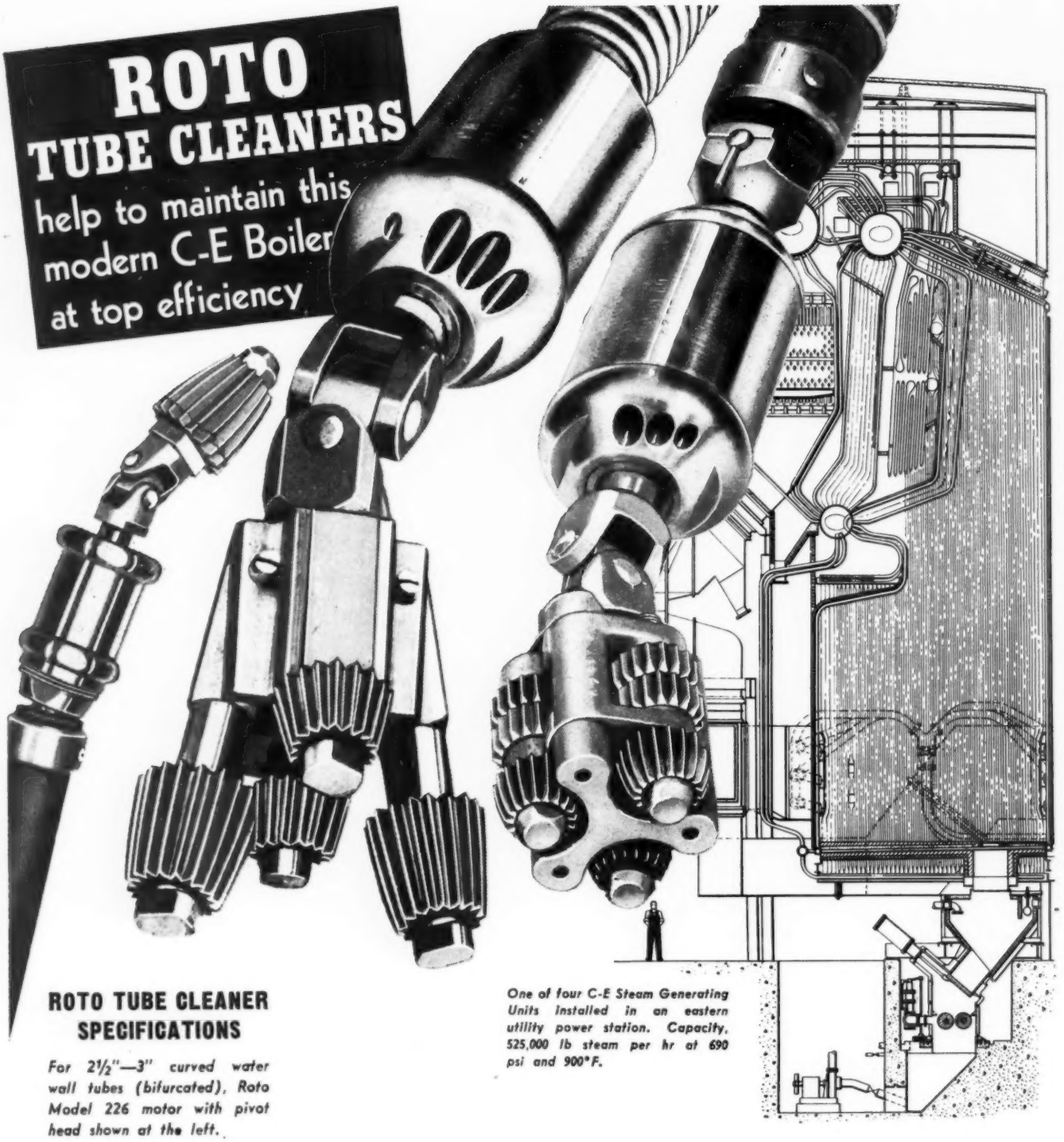
help to maintain this modern C-E Boiler at top efficiency



One of four C-E Steam Generating Units installed in an eastern utility power station. Capacity, 525,000 lb steam per hr at 690 psi and 900°F.

ROTO TUBE CLEANER SPECIFICATIONS

For 2½"—3" curved water wall tubes (bifurcated), Roto Model 226 motor with pivot head shown at the left.

For 3" curved steam generating tubes and 3" curved water wall tubes, Roto Model 125 motor with 4-arm head.

For 3½" curved water wall tubes, Roto Model 130 motor with swing-frame head.

The modern, highly efficient steam generator with its closely nested tubes having short radius bends calls for a modern tube cleaner capable of negotiating the curves. The huge steam generator illustrated was built by Combustion Engineering Co. for a public utility. Listed in the specifications is the Roto Tube Cleaner equipment furnished for this modern palnt.

Since 1910 the Roto Division has specialized in tube cleaners for all types and sizes of tubular heat transfer equipment. Our complete stock of cleaners and accessories permits immediate delivery. Write, wire or phone.

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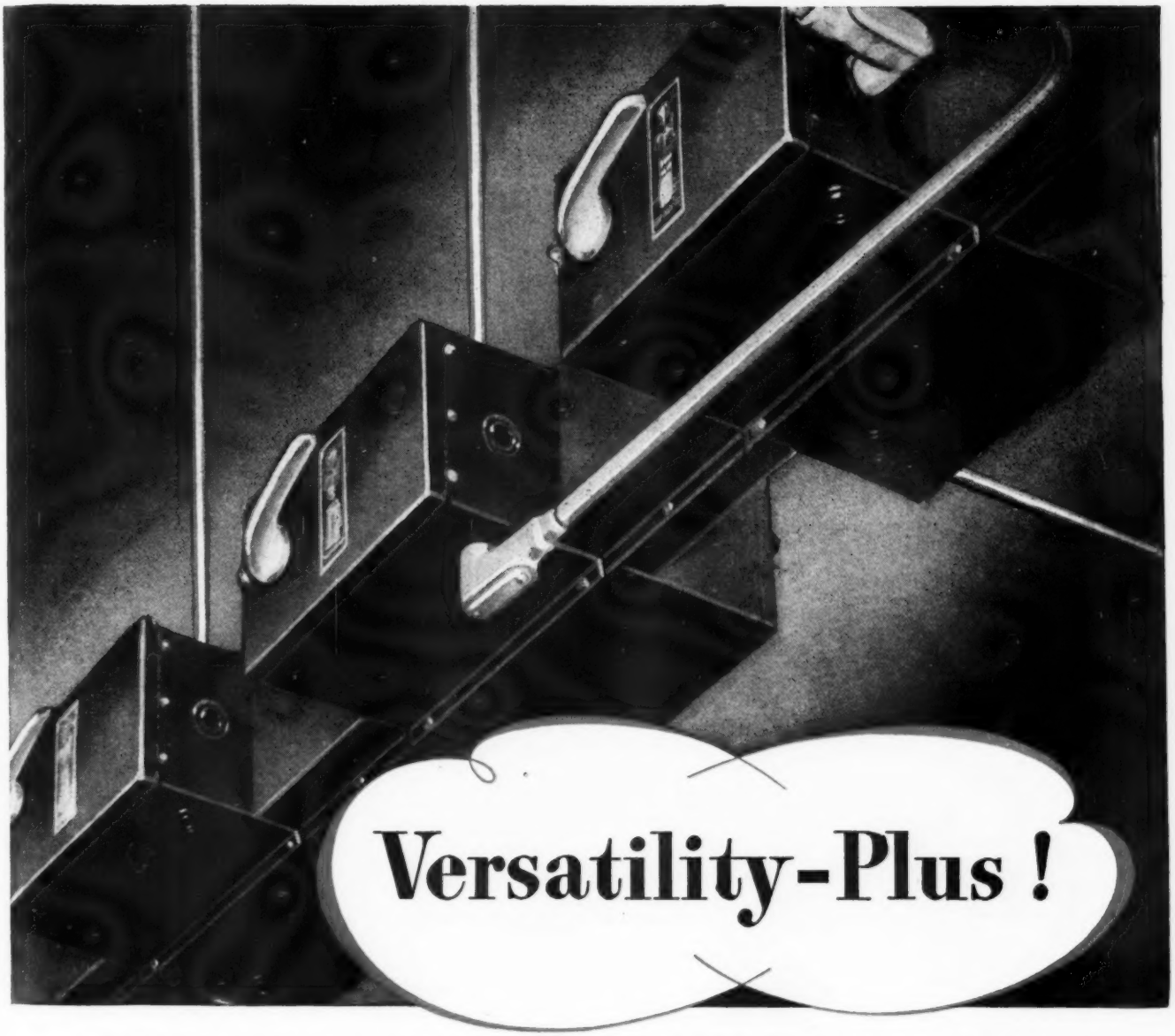

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BULLDOG BUSTRIBUTION DUCT FOR "PLUG-IN" POWER . . . ANY TIME : : : AT ANY POINT

Conversion goes on ALL THE TIME in industrial plants—not just during or after a war.

Production lines must constantly be re-arranged to meet new or altered manufacturing schedules. Machines may work in many different locations during their service lifetime.

With old-type *fixed* outlet systems, re-wiring to accommodate these changes is slow and costly. Not with BullDog BUStribution Duct—the original "plug-in" system gives you electrical power *whenever* and *wherever* you need it.

This system—result of half a century of leadership in the electrical distribution field—gives you the finest *flexible* set-up for all your power needs. It's *plus* in everything but price—100% salvable, too.

Investigate BUStribution Duct for *your* plant. Consult BullDog field engineers or write us direct.

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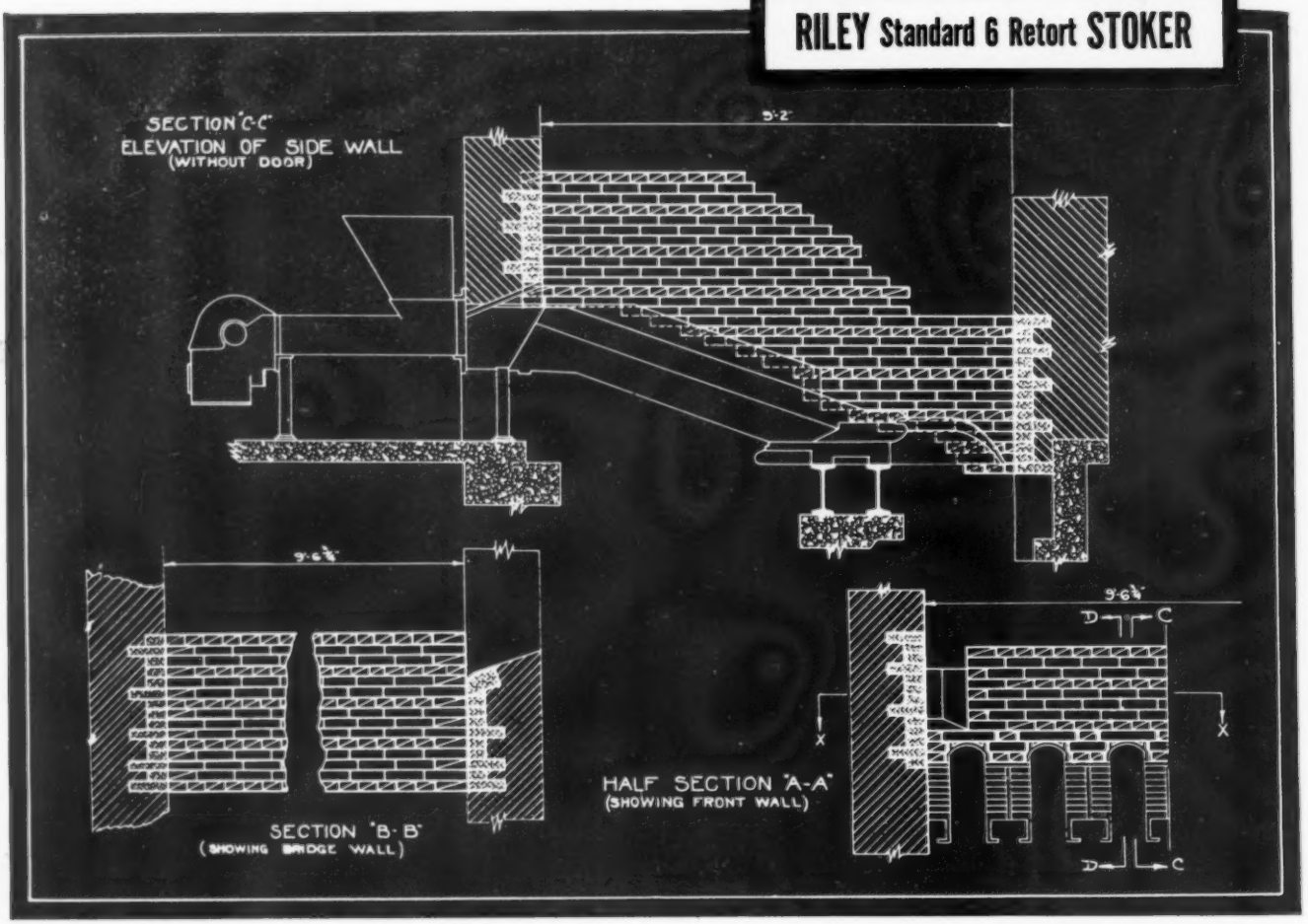
Engineered for More and Cheaper Steam

WALL BRICK DATA

RILEY Standard 6 Retort STOKER



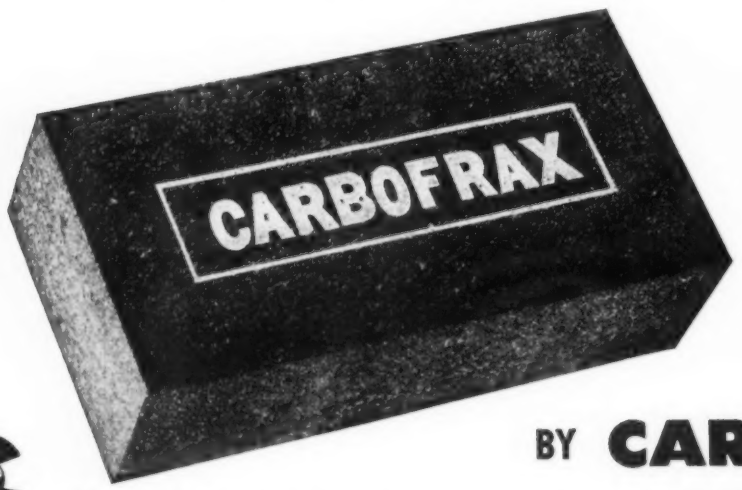
A recommended method of installing CARBOFRAX silicon carbide brick in a boiler setting fired with a Riley *standard six retort* Stoker is shown by the above illustration. The actual height of coverage is, of course, governed by operating conditions. But through the use of CARBOFRAX brick the end result is more and cheaper steam.

Greater steaming capacity is a corollary to the installation of a CARBOFRAX lining. When used throughout and a few courses above the clinker zone, CARBOFRAX brick largely eliminate massive clinker formations. The full grate area is in use at all times for more efficient combustion.

Greater production is also related to the longer life obtained from CARBOFRAX linings. Furnaces are kept in steady service. Outages for lining repairs are rare as contrasted with the performance of ordinary refractories.

This longer life, in turn, means cheaper steam. Eight to ten years of service from CARBOFRAX brick is by no means unusual. And with the excellent foundation which they provide the upper walls require repairs less frequently. A reduction in both labor and materials costs follows.

Engineering data on CARBOFRAX brick for boiler furnaces is yours for the asking. Write Dept. G-16 and we'll send it to you promptly. The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



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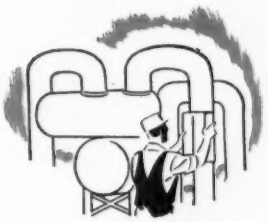

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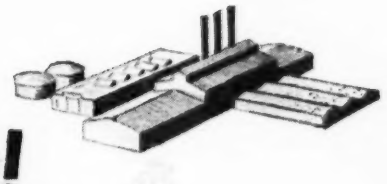

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POWER will be needed—and how—for industry's great program of post-war production! But, more than ever, power engineers must watch cost figures...figure out new economies.

Consider seriously therefore the question of *modernizing* your boiler room through the installation of Todd Oil or Gas Burners.

Savings up to 10%, on the one hand...increased power on the other . . . for Todd Burners' instantaneous response to fluctuating demands produces *more* steam on *less* fuel consumption!

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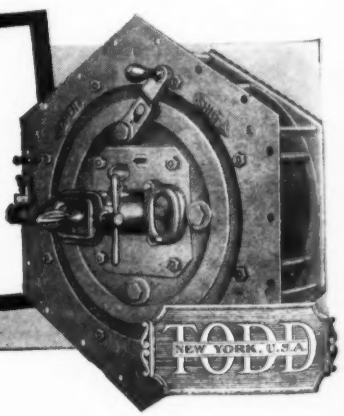

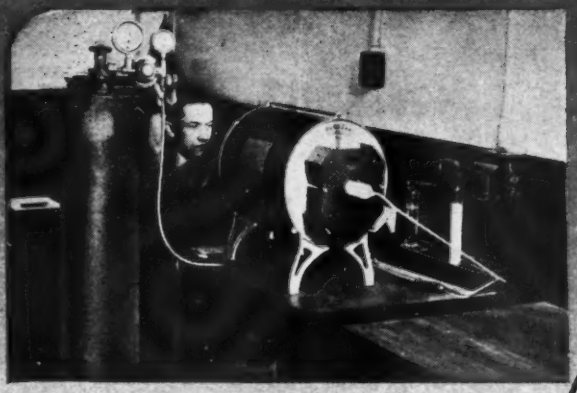

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Determining the amount of essential elements from steel samples.

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To assure selection of the correct steel, carbon or alloy pipe to meet varying operating conditions, Kellogg maintains a program of continuous research and tests. Chemists, metallurgists and process engineers work closely with the mechanical engineers. The result is a correctly designed and fabricated installation that will render long and satisfactory service.

On your next difficult piping job, consult KELLOGG.

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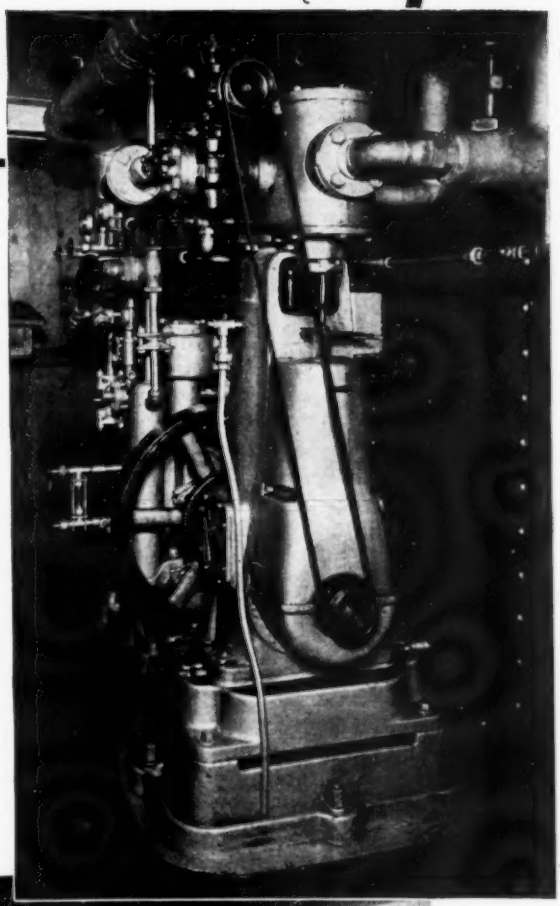
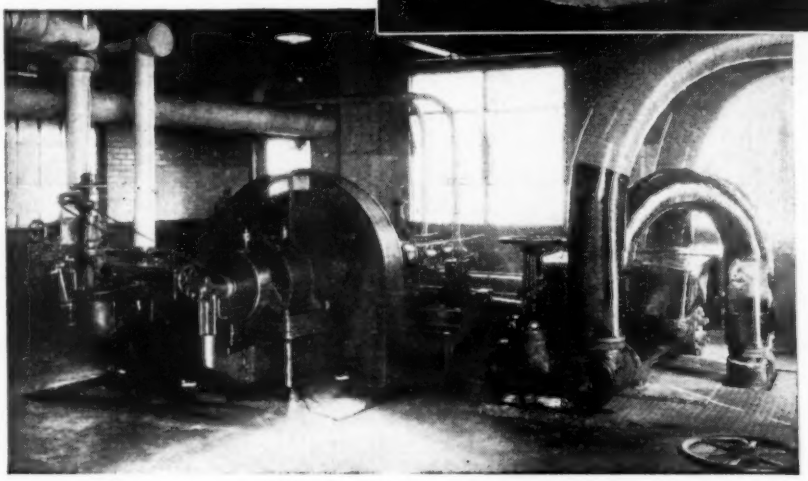
FOR REDUCTION IN POWER COSTS



IMPROVED designs of stokers and boilers are helping plants offset rising fuel and labor costs in steam generation, but that is not the limit to which economies can be carried. In most plants where steam is generated for processing purposes another important saving can be made by utilizing By-Product Power in the steam.

In many cases, steam passes through a pressure reducer before passing to its ultimate destination. To obtain By-Product Power, pass the steam through a Troy-Engberg Steam Engine, instead of the pressure reducer. The power thus converted can be used to drive generators, stokers, compressors, ventilating systems and many other types of equipment. Power savings thus effected will quickly pay for your Troy-Engberg Engine — in some instances in as little as six months.



Ask for Troy's recommendations in your own set-up. There is no obligation, of course.

Send for Bulletin 306

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Established 1870

2511 Railroad Avenue **Troy, Pennsylvania**

12-TEM-2

Thermoid —Key to Progress in Many American Industries

The old method of getting bricks to the bricklayers has been superseded by the modern Thermoid Conveyor Belt

Here's the modern method. This Thermoid Belt was chosen because neither weather nor the sharp bricks will injure the belt.

SINCE 1880, Thermoid has contributed to the progress of American Industry. In many fields of business Thermoid Products play an indispensable part. For instance, the George Haiss Manufacturing Company, manufacturers of portable conveying equipment, chose Thermoid Conveyor Belting for the portable brick conveyor shown above.

The Thermoid Line* is the result of 65 years of research and experience that not only has kept pace with the demands of industry, but in many cases anticipated industry's needs.

The Thermoid Line* of belting and hose for materials handling and power transmission may contain the key to another step forward in the improvement of your process and the reduction of your costs.—"It's Good Business to Do Business With Thermoid."

***THE THERMOID LINE INCLUDES: Transmission Belting • F.H.P. and Multiple V-Belts and Drives • Conveyor Belting • Elevator Belting • Wrapped and Molded Hose • Sheet Packings • Industrial Brake Linings and Friction Products • Molded Hard Rubber and Plastic Products.**

Thermoid Rubber

DIVISION OF THERMOID COMPANY

TRENTON 6, NEW JERSEY

Contributor to Industrial Advancement Since 1880

These Bulletins Will Help Solve Your PUMPING PROBLEMS

In many a plant where liquids are part of the product, pumping problems are headaches.

Because "Buffalo" engineers have specialized for many years in industrial pump work, they are well fitted to suggest the right equipment for your process.

Because the "Buffalo" line is wide and includes many specially developed designs you can be sure that the pumps they recommend will be efficient, practical pumps.

The bulletins illustrated are some of those available now to help you select the most efficient pumps for your requirements.

Buffalo sales representatives located in all principal cities will be glad to supply these and make recommendations, or write us.

BUFFALO PUMPS, Inc.

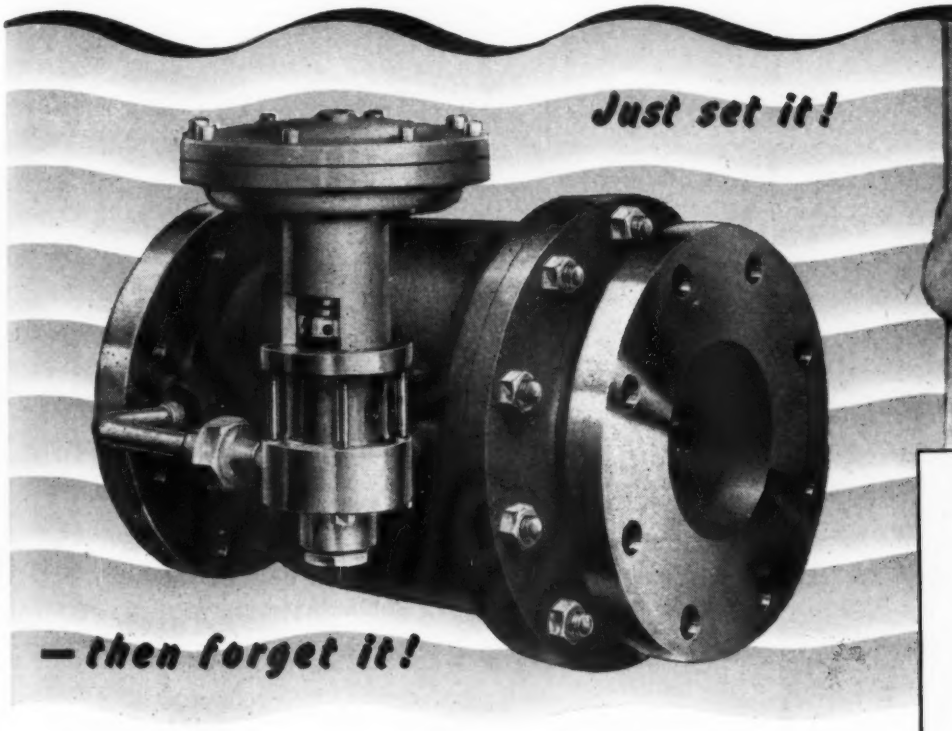
488 Broadway Street, Buffalo, N. Y.

CANADA PUMPS, LTD., Kitchener, Ont.

"Buffalo" **PUMPS FOR INDUSTRY**

Instantly Responsive Back Pressure or Relief

...as Sensitive as a Human Hair to a Breath of Air

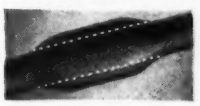


. . . IN HANDLING
all types of
LIQUIDS & GASES
Including: HIGHLY Volatile and Reactive Fluids

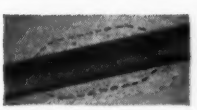
Insures POSITIVE *Bubble-Tight* Shut-off

As it requires only a slight increase in line pressure to operate the Grove Flexflo fully self-contained Back Pressure Regulator or Relief Valve, it is possible to set it for instantaneous "hair-trigger" response. There is absolutely no chance for "hang-up" or sticking to occur. Flexive expansible tube insures smoother, quieter operation with positive bubble-tight shut-off and dependable leak-proof service in controlling all types of liquids and gases. It is entirely unaffected by suspended solids in the flowing stream and automatically self-compensates for any erosion or wear. No packing glands or stuffing boxes are employed, which eliminates leakage losses, hazards and failure. Sizes range from 1½" to 12" for standard pressures—also designed for pressures from 200 to 2500 lbs.

HYDRAULICALLY AND PNEUMATICALLY SELF-OPERATING



EXPANDS TO OPEN



CONTRACTS TO CLOSE

GROVE *Automatic... Self-Operating* FLEX-FLO

BACK PRESSURE REGULATOR—OR RELIEF VALVE

GROVE REGULATOR COMPANY

6527 GREEN STREET, OAKLAND 8, CALIFORNIA • *Branch Offices:* 30 Rockefeller Plaza, New York 20 • 5644 Navigation Boulevard, Houston 11, Texas • 1930 West Olympic Boulevard, Los Angeles 6, California

POWER

. . . by Special Delivery

Speeding fuel to your power plant is but one of *many* difficult materials handling jobs you can count on a Robins Conveyor System to do efficiently and economically.

That's because Robins Conveyor Systems are *Job-Engineered* to deliver maximum tonnages in minimum time. You enjoy the advantages of special delivery service . . . because your Robins Conveyor System is designed to meet your exact requirements.

Why not find out how a *Job-Engineered* Robins Conveyor System can save you time and money all along the line. A note or call will bring a Robins *Job-Engineer* to your desk.

A Robins Conveyor System moves coal from railroad cars to power house at the Government's atomic bomb plant, Oak Ridge, Tenn.

AMERICA'S ONLY *COMPLETE* MATERIALS HANDLING SERVICE

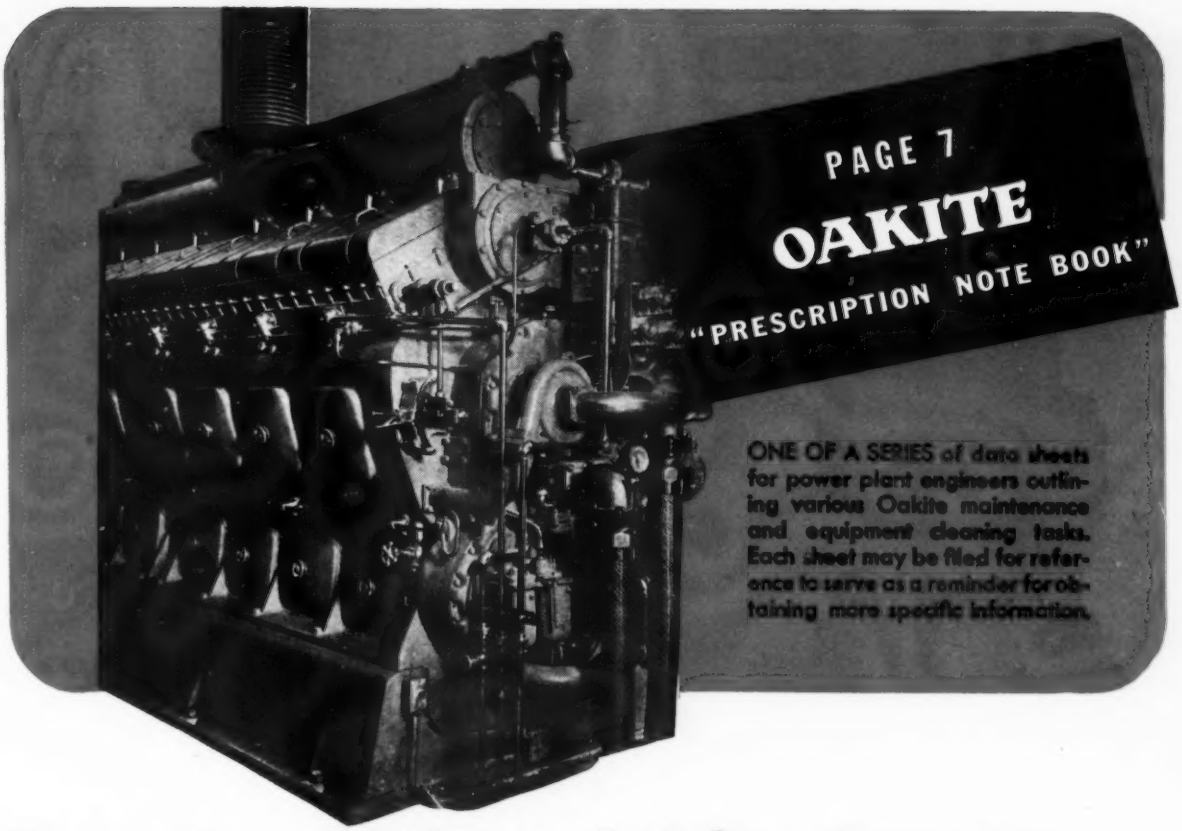
Hewitt and Robins unite to offer you 136 years of combined experience in Job-Engineered rubber products and machinery designed to answer every materials handling problem you may have.

ROBINS

CONVEYORS, INCORPORATED

PASSAIC, NEW JERSEY

DIVISION OF HEWITT RUBBER CORPORATION



PAGE 7

OAKITE

"PRESCRIPTION NOTE BOOK"

ONE OF A SERIES of data sheets for power plant engineers outlining various Oakite maintenance and equipment cleaning tasks. Each sheet may be filed for reference to serve as a reminder for obtaining more specific information.

Removing SCALE and Other Deposits from Diesel Engine WATER JACKETS

Deposits of calcium and magnesium carbonates, rust, slime, oil, grease and other foreign matter which often form in Diesel engine water jackets are among the common causes of overheating and resultant thermal stresses. That is why regular maintenance is so important in order to dissipate the intense heat of compression and combustion. Proper maintenance will prevent clogging of system . . . permit circulating water to make direct contact with metal surfaces of jackets.

OAKITE COMPOUND No. 32

and other recommended Oakite materials have long provided a successful answer for descaling and cleaning Diesel engine water jackets and cooling systems. Economical to use, these various Oakite materials, applied as directed, help shorten downtime, make maintenance a comparatively simple task. Booklets and Special Service Reports describing Oakite methods are available to all Diesel engineers and operators. They are free for the asking. Send today!

OAKITE PRODUCTS, INC., 23 Thames St., NEW YORK 6, N. Y.

Technical Service Representatives in All Principal Cities of the United States and Canada

Other Power Plant Cleaning Jobs for OAKITE

Automatic Filters . . . Electrical Precipitators . . . Controlling Slime and Scale Formation in Air Wash Air Conditioning Units . . . Cleaning Evaporative Condenser Coils . . . Controlling Slime and Mold in Humidifying Systems . . . Cleaning and Descaling Diesel or Gasoline Engines . . . Cleaning and Descaling Jacket Water Coolers and Lube Oil Coolers . . . Cleaning Surface Condensers . . . Cleaning Water and Steam Condensate Meters . . . Descaling Water Cooled Compressors . . . Cleaning Unit Heaters . . . Descaling Ammonia Condensers . . . Cleaning Transformers . . . Cleaning Painted Surfaces of Equipment . . . Stripping Paint . . . Cleaning Floors.

OAKITE *Specialized* **CLEANING**

MATERIALS • METHODS • SERVICE

NOTE: The Oakite Technical Representative in your locality is ready to give you the benefit of his experience and personal help on any power plant cleaning or related problem. This Advisory Service is free.

- **RELIABILITY**
- **STRENGTH**
- **ECONOMY**
- **SAFETY**

. . . characteristics of every **KENNEDY** *valve*

Kennedy Valves are reliable because of their simple, sturdy and effective operating mechanisms. Many of these mechanisms were originated by Kennedy, and have proven their effectiveness in thousands of installations.

These valves are economical because of their durability which has been demonstrated by decades of service in many installations without maintenance expense.

Their generous proportions of all parts, together with high-quality, high-tensile-strength metal, assure ample strength and complete safety. You are always safe with Kennedy "Extra Value" Valves.

THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK

KENNEDY *valves . . . pipe fittings . . . fire hydrants*

A THRILL PACKED ROLLER COASTER IS SAFER NOW

because

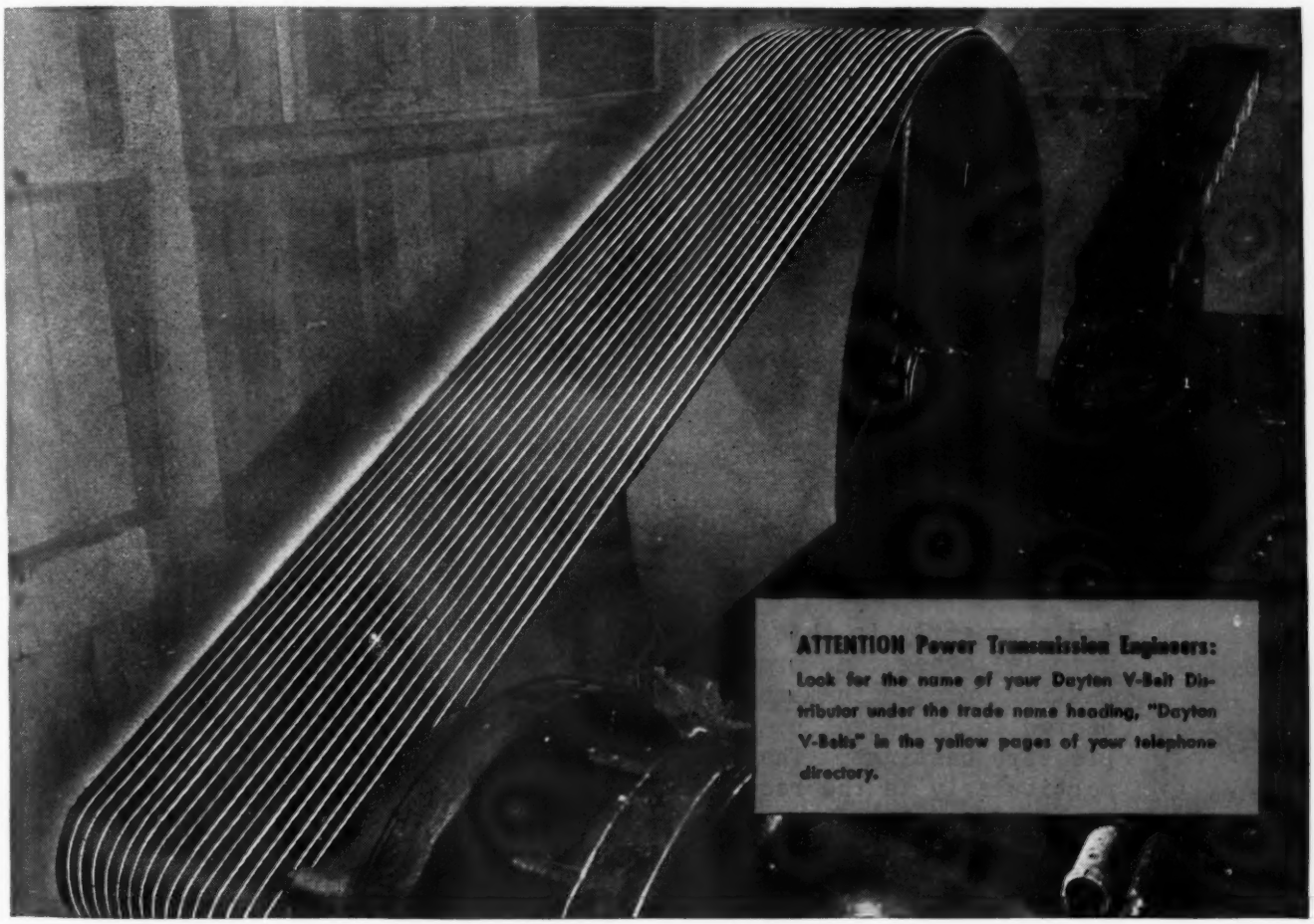
THE MACHINERY THAT STARTS THE CARS ON THEIR DIZZY TRIPS IS NOW EQUIPPED WITH

DAYTON V-BELT DRIVES

that ELIMINATE VIBRATION

The original drive on this roller coaster's machinery caused so much vibration that parts loosened rapidly, wore out quickly, creating a safety hazard as well as keeping maintenance costs high. Since Dayton V-Belts were installed, vibration has been eliminated, the safety hazard has disappeared and maintenance costs have been cut in half. In thousands of industrial plants Dayton V-Belt Drives are eliminating vibration and reducing maintenance costs and, in addition, are eliminating slippage and noise, saving space, providing positive power control and operating under the toughest conditions. They can do these things because they are *engineered* for their jobs . . . the result of a research experience of 40 years working with natural and synthetic rubbers, making *specialized* rubber products for specific industrial jobs. This is why Dayton V-Belts can solve your power transmission problems. Write for full information.

THE DAYTON RUBBER MANUFACTURING COMPANY
Dayton 1, Ohio


ATTENTION Power Transmission Engineers:
Look for the name of your Dayton V-Belt Distributor under the trade name heading, "Dayton V-Belts" in the yellow pages of your telephone directory.

SEND FOR THE LATEST DAYTON V-BELT CATALOG

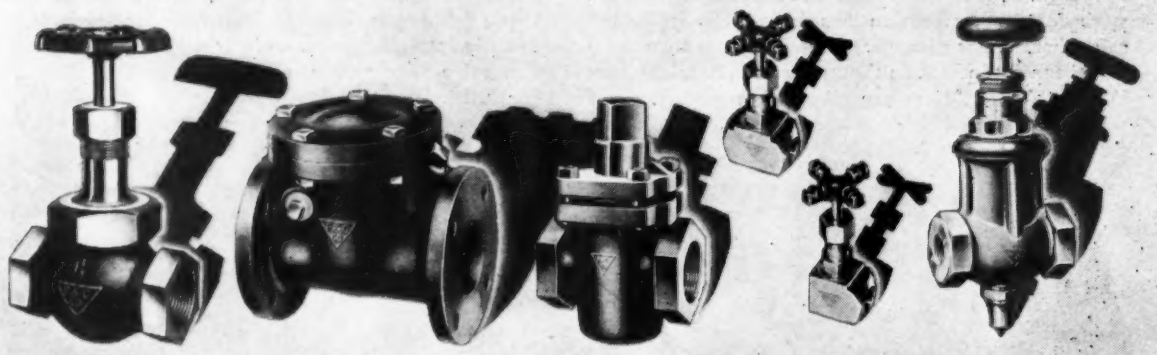
This 384-page book gives complete engineering data and tables for figuring any power transmission drive quickly and easily. Your copy is FREE. Write today, The Dayton Rubber Manufacturing Company, Dayton 1, Ohio.

Dayton Rubber

THE WORLD'S LARGEST MANUFACTURER OF V-BELTS

THE WAY TO BETTER VALVES

READING-PRATT & CADY



Globe Valve—with renewable slip-on disc—patented by Pratt & Cady.

Swing Check—patented by Pratt & Cady.

Asbestos-Packed Cock—introduced in U. S. by Pratt & Cady.

Bar Stock Globe and Angle Valves—originated by Reading-Pratt & Cady.

Piston Internal Pilot Controlled Automatic Regulating Valve—originated by d'Este.

During the last century, when the now ordinary valve types were being originated and patented, Pratt and Cady contributed, among others, such items as the slip-on disc for globe valves and the swing type of check valves. d'Este originated the piston internal pilot controlled regulator. This activity continuing to present times is illustrated by the bar stock valves originated by Reading-Pratt and Cady.

And when early in this century, a need developed for a valve material other than brass and iron and the available steel castings proved inadequate, Reading specialized and pioneered in the development of the art of producing steel pressure castings. That development has been continuous, particularly as the requirement for alloy steels has appeared and increased.

The way to better valves is to continue development.

Reading Cast Steel Valves and Fittings • Pratt & Cady Brass and Iron Valves
d'Este Automatic Regulating Valves • Helicoid Pressure Gages
READING-PRATT & CADY DISTRIBUTORS IN PRINCIPAL CITIES

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Reading, Pa. • Atlanta • Chicago • Denver • Detroit • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

Rittenhouse Plaza Apartments, Philadelphia, Pa. Mr. N. Allen Brandriff, managing agent. Ralph B. Bencker, architect; Wm. M. Anderson, mechanical engineer and heating contractor.

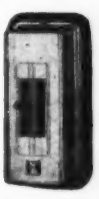
Since 1925—
APARTMENT CONVENIENCE • SMALL HOME COMFORT

Look at the small, inconspicuous instrument on the wall. Think of the constant, watchful service which it performs. A Johnson thermostat, in each room, commands the operation of the heating system, which is far away in the basement. Here is another modern wonder of science!

"For twenty years," says Mr. Brandriff, managing agent of the Rittenhouse Plaza Apartments in Philadelphia, "tenants have enjoyed the comfort of individual room heat control . . . The automatic control has functioned with a minimum of maintenance. In addition to the comfort, we enjoy a considerable fuel saving, by eliminating the overheating always experienced when radiators are controlled manually."

That is why 561 Johnson "Room-by-Room" Thermostats were installed in Rittenhouse Plaza. The fact that even more than the expected comfort and fuel saving have been experienced, in this building, is another reason why Johnson is called upon, time after time, to solve the next automatic temperature control problem for the same people. The Johnson organization—designing, manufacturing, engineering and installing—is well known as a corps of temperature control experts.

Johnson control may be installed in either existing or new buildings. Ask for a Johnson engineer from a nearby branch office. With no obligation whatsoever, he will make a survey and recommendations, in cooperation with your heating contractor. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin, Direct Branch Offices in Principal Cities.

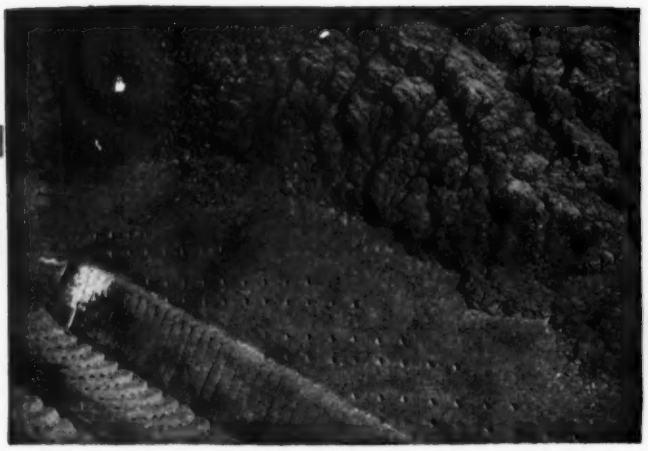


JOHNSON *Automatic Temperature and Air Conditioning* **CONTROL**

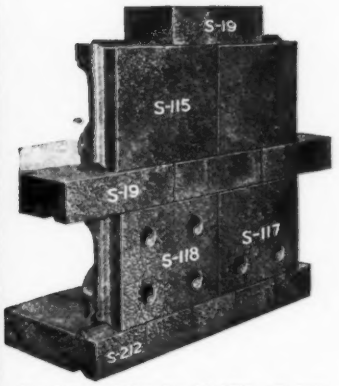
DESIGN • MANUFACTURE • INSTALLATION • SERVICE

How to Cut Down on Your Furnace Maintenance

Rear View of Bernitz "S-100" All "T" Super Block Construction



Central Station Furnace After 18 Months' Hard Service at 300-350% Rating



Fire-Face of Bernitz "S-100" All "T" Block Construction

Air Cooled BERNITZ SUPER BLOCKS End Bothersome Clinker Adhesion

ABOVE you see an example of how BERNITZ SUPER BLOCKS keep clinker from sticking to side walls. How do they do it?

By taking advantage of the properties of silicon carbide, from which they are made. Silicon carbide naturally resists clinker adhesion, and it has very high heat conductivity. It also has great mechanical strength.

BERNITZ SUPER BLOCKS are recessed to the thinnest practical cross section to promote cooling. Then air is passed behind or through them to keep them cool. By keeping their temperature below the fusion temperature of the ash in the coal it becomes impossible for clinker or slag to penetrate their tough skin. That's how simple it is.

In these days of poorer coals, thousands of furnaces equipped with BERNITZ SUPER BLOCKS in hundreds of plants are operating year after year without maintenance. They can insure reduced outage and maintenance for you, too. They are easy to install in new or existing settings. Write for Bullein B-344 which describes and illustrates applications for these truly SUPER BLOCKS.

BERNITZ FURNACE APPLIANCE CO. • 89 BROAD ST., BOSTON 10, MASS.

New York Philadelphia Detroit Buffalo Syracuse Atlanta Pittsburgh Cincinnati Chicago Indianapolis Minneapolis St. Louis Cleveland
In Canada: Williams & Wilson, Ltd., Montreal and Toronto

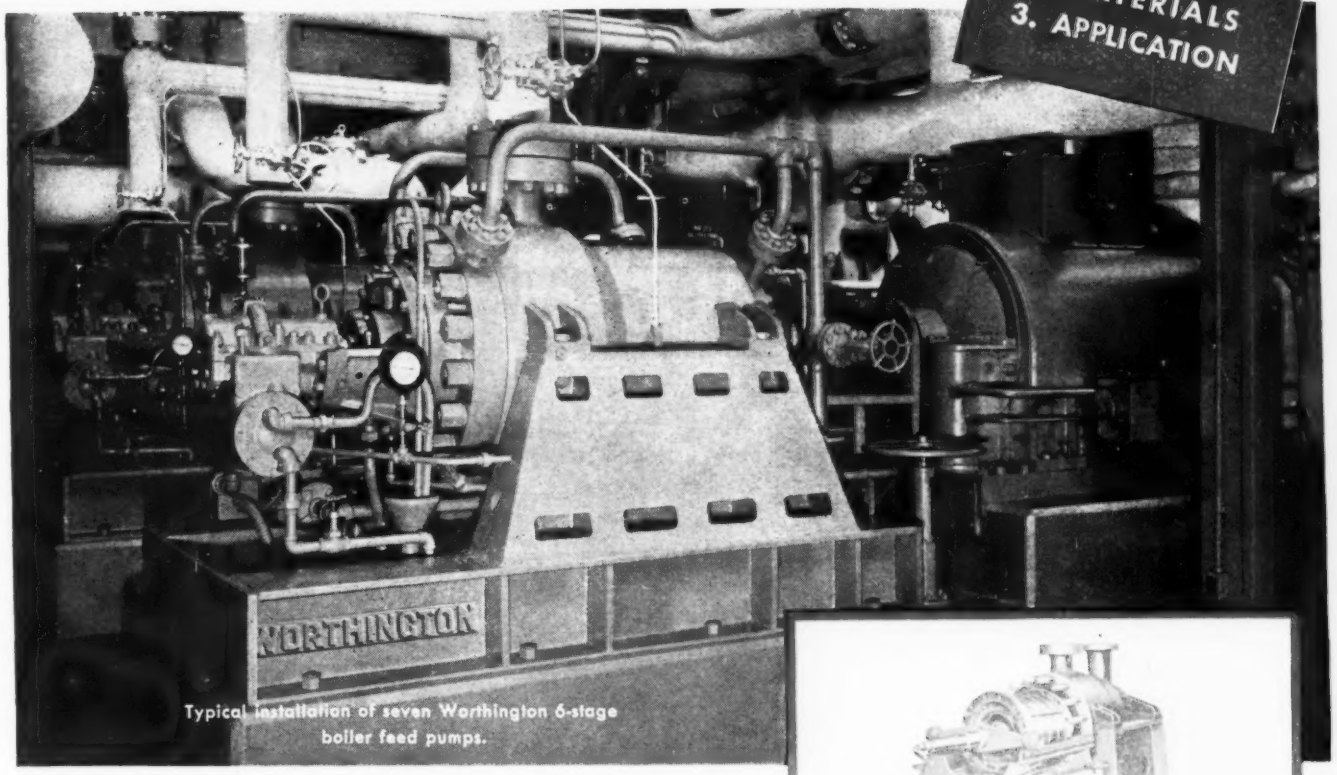
BERNITZ SUPER BLOCKS

OTHER PRODUCTS INCLUDE:

BERNITZ FURNACE LININGS
BERNITZ NYGAARD WATER WALL BLOCKS FOR WALLS AND ARCHES
BERNITZ AIR-COOLED FLOORS
BERNITZ SUPERGENERATOR LININGS FOR WATER GAS SETS

WHY WORTHINGTON HIGH-PRESSURE PUMPS *excel in all three . . .*

1. DESIGN
2. MATERIALS
3. APPLICATION



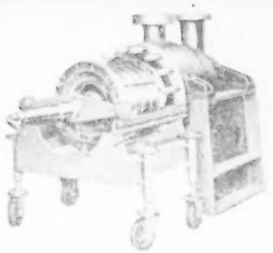
Typical installation of seven Worthington 6-stage boiler feed pumps.

1. DESIGN —Worthington has longer experience in manufacturing high-pressure centrifugal boiler feed pumps . . . has acquired unique constructive ideas from power-plant operating engineers. That's why you'll find such superior design features in Worthington high pressure boiler feed pumps as: a balancing device construction that minimizes wear; bolted ring-type pressure joints; impellers shrunk on the shaft; oversized Kingsbury thrust bearings.

2. MATERIALS —Worthington has greater facilities for research. That's why you'll find the *right* materials in Worthington high-pressure boiler feed pumps: stainless steel for internal parts—to prevent destructive corrosion and erosion; forged steel casings—tested and proved by years of power plant operation.

3. APPLICATION —Worthington Pump Application Engineers are thoroughly versed in every phase of applying the most complete line of boiler feed pumps for high or low pressures — capacities from 50 to 3500 GPM . . . pressures from 50 to 2500 PSI. That's why Worthington will fit the *right* feed pumps to your feed cycle.

For further details on Worthington High-Pressure Boiler Feed Pumps . . . or for an appointment with a Worthington P.A.E.*, write us or telephone the nearest of our 36 district offices. You'll find that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Centrifugal Pump Division, Harrison, N. J.*



AS EASY TO DISMANTLE AND ASSEMBLE AS A SPLIT-CASE PUMP

Complete rotor assembly of Worthington High-Pressure Boiler Feed Pump can be withdrawn *in one piece* on a portable assembly truck without disturbing suction or discharge piping connections. Simplifies inspection, replacement or repair of internal parts.

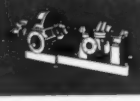
*Pump Application Engineer

WORTHINGTON

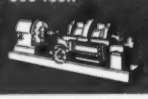
24CB-3

THE WORLD'S LARGEST MANUFACTURER OF PUMPS

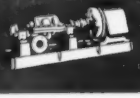
For Boiler Feed Service
Capacities from 30 to 1500 g. p. m. Heads from 180 to 1000 feet.



For Hotwell, Condensate, Chilled Water, General Service
Capacities from 150 to 1300 g. p. m. Heads from 110 to 500 feet.

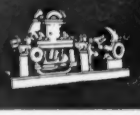


For Boiler Feed Service
Capacities from 25 to 1450 g. p. m. Heads from 220 to 1600 feet.

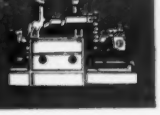


For Water Works, Circulation, Drainage, General Service
Capacities from 500 to 1600 g.p.m. Heads 900 to 3200 feet.

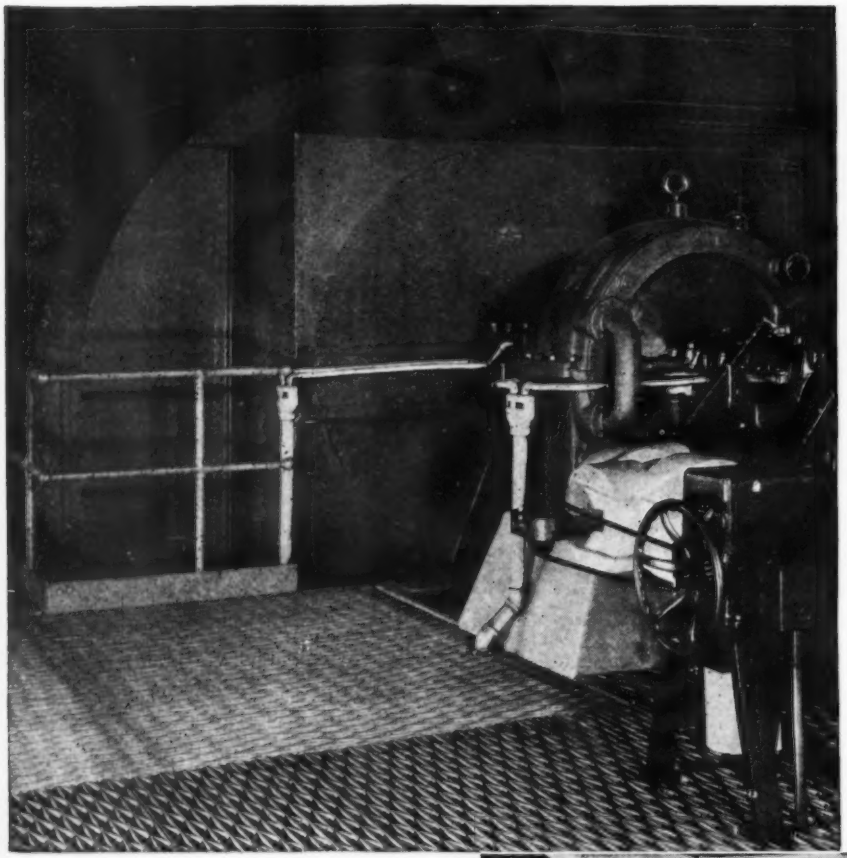
For Boiler Feed Service
Capacities from 200 to 1600 g. p. m. Heads from 900 to 3200 feet.



For Boiler Feed Service
Capacities from 500 to 3000 g. p. m. Heads from 2000 to 7000 feet.



Maximum C.F.M. per horsepower



When you pick power plant fans or ventilating fans, get the maximum c.f.m. per horsepower! That doesn't necessarily mean the fan with the highest rating. It does mean the fan which, on the job, lasts longest and requires least "time out" for maintenance.

Buffalo fans have initial high efficiency due to their modern design, which incorporates the non-overloading horsepower characteristic. They are ruggedly constructed for heavy duty service.

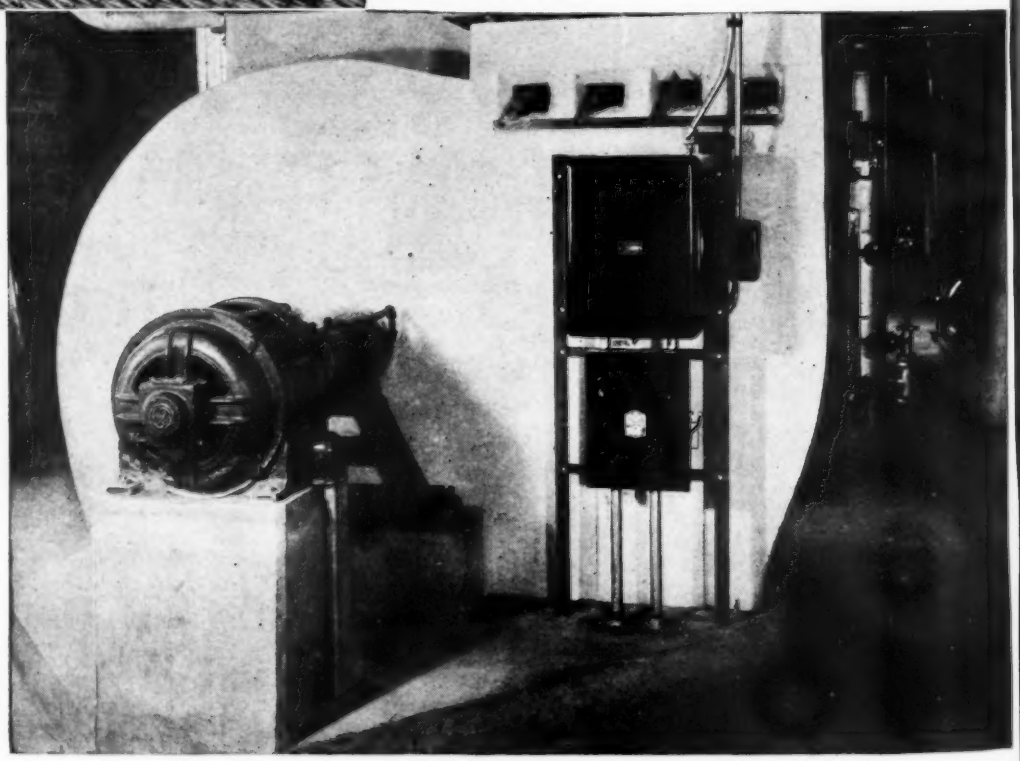
Users find that they give fine performance over a long life span.

Buffalo representatives in principal cities will be glad to work with you or your consulting engineer.

BUFFALO FORGE COMPANY

488 Broadway Buffalo, N. Y.

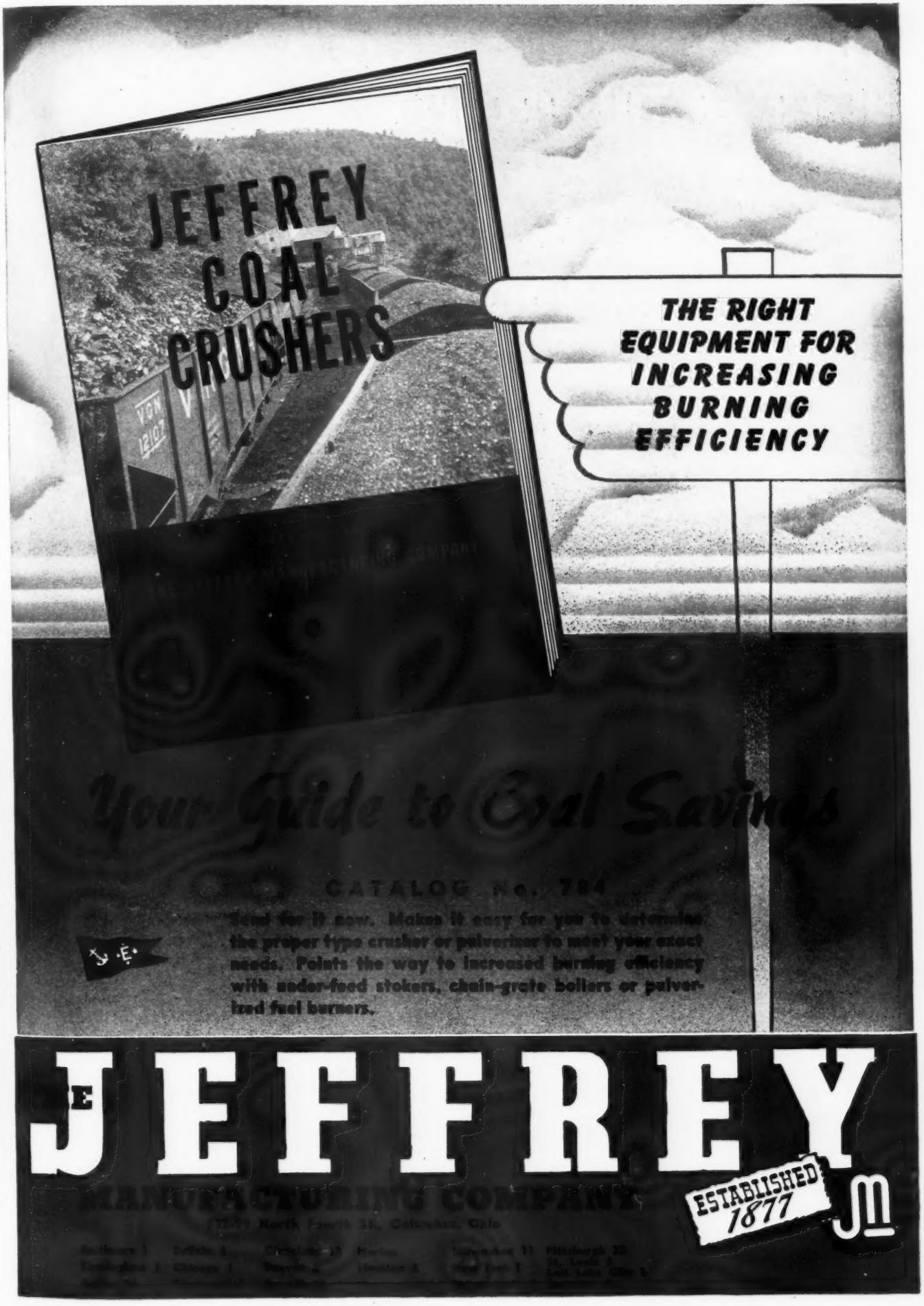
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.



Buffalo Forced and Induced Draft Fans are "built-to-order" to fit the requirements of the job.

"Buffalo" First for Fans

FANS for Power Plants


JEFFREY
COAL
CRUSHERS
THE RIGHT
EQUIPMENT FOR
INCREASING
BURNING
EFFICIENCY
Your Guide to Coal Savings
CATALOG No. 784
Send for it now. Makes it easy for you to determine the proper type crusher or pulverizer to meet your exact needs. Points the way to increased burning efficiency with under-feed stokers, chain-grate boilers or pulverized fuel burners.
JEFFREY
MANUFACTURING COMPANY
ESTABLISHED 1877

YOUR SAFETY DESERVES THE PROTECTION OF A Farris SAFETY VALVE

HERE'S A PRECISION-OPERATING VALVE FOR SERVICE UP TO 600 LBS.—750°F.

You're looking at the FARRIS type 2575 Full Venturi Safety Valve. Its design was determined *by actual field service* — without consideration of manufacturing standardization...

Type 2575 combines all the outstanding advantages of FARRIS design such as the one-piece Venturi port (which also forms the gasket face) . . . secondary orifice with preselected capacity . . . single blow-down ring . . . center-guide bushing . . . separator bell . . . dual test-lever. Six *advanced* features that spell unprecedented boiler safety!

When you specify a FARRIS type 2575, you get a precision-operating instrument . . . you get minimum blow-down, non-shock operation . . . and rapid, high-capacity relief of overpressure.

You owe it to the safety of your whole plant to specify a safety valve of the most advanced design and construction available.

So why not write for the new *FARRIS catalog NOW — while our address is before you.*

FE-524

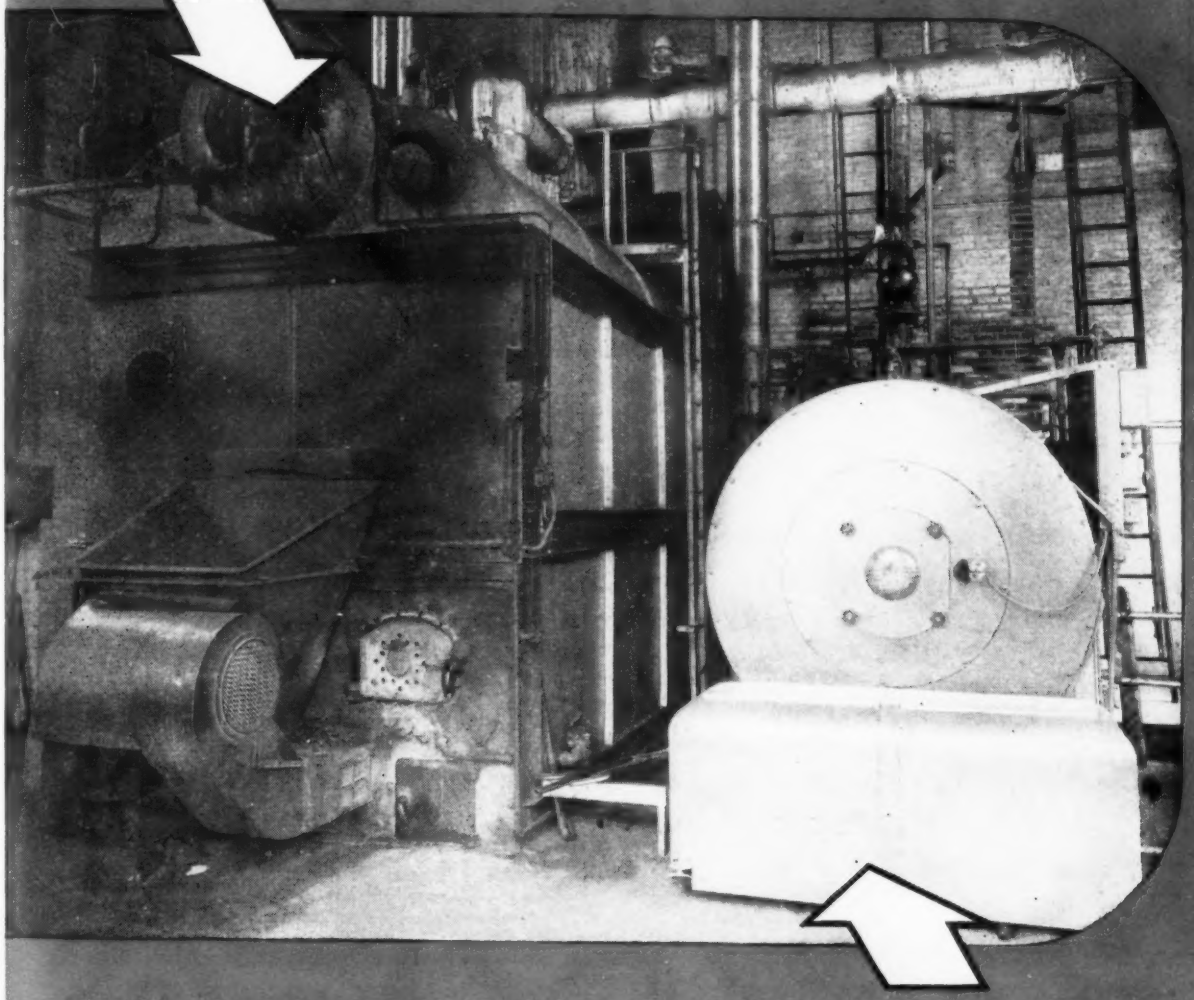
WRITE TODAY FOR THE *New* FARRIS CATALOG

FARRIS ENGINEERING COMPANY
366 Commercial Ave., Palisades Park, N. J.

Farris
SAFETY and RELIEF VALVES

FARRIS KEEPS PACE WITH ADVANCING POWER AND PROCESS ENGINEERING

THE OLD



YORK 4h HEAT

is giving way to **THE NEW**

STEAM-PAK YORK 4h HEAT

FRANCHISES OPEN

If you can sell Industrial oil-fired boilers, investigate the opportunity of selling STEAM-PAK . . . part of the world's most complete line of Domestic, Commercial, Industrial, and Marine equipment. Write, phone, or wire York-Shipley, York, Penn.

This modern STEAM-PAK GENERATOR unit, installed in a dairy, cut average daily fuel costs from $8.73 to $6.41. Here it is, shown side by side with the former stoker-fired equipment. We are making compact, efficient, easily-maintained STEAM-PAK GENERATORS now—the modern answer to every steam-generating problem.

INDUSTRIAL DIVISION

YORK-SHIPLEY *INCORPORATED*

YORK • PENNSYLVANIA

Here's Money-Saving Protection For Your Compressed Air Operated Machinery and Instruments

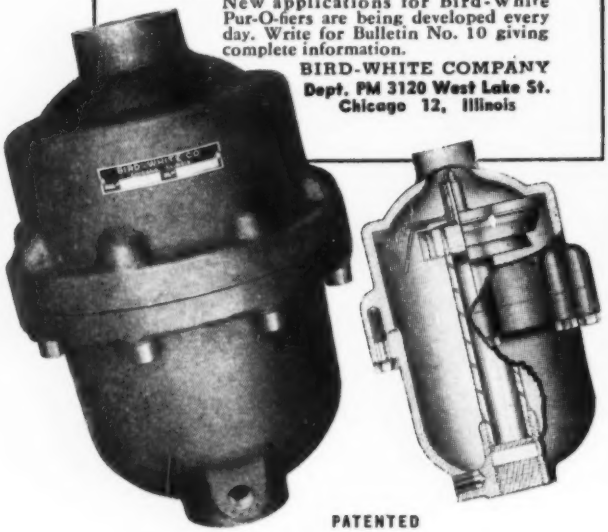
Now, regardless of volumes required or fluctuating pressures, the new Bird-White Pur-O-fiers completely and effectively remove all moisture, oil, dirt and other foreign matter from compressed air or gas lines—preventing costly corrosion and gumming in compressed air-operated machinery and instruments.

Operating on the principle of centrifugal action, a high speed Turbo-rotor forces the tiny particles of foreign matter outward where they are trapped and drained off.

Single units can accommodate up to 100 cubic feet. Above this range multiple units are recommended.

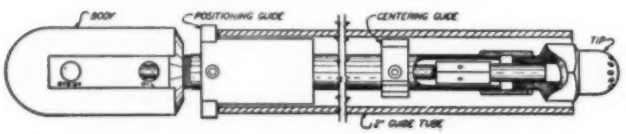
New applications for Bird-White Pur-O-fiers are being developed every day. Write for Bulletin No. 10 giving complete information.

BIRD-WHITE COMPANY
Dept. PM 3120 West Lake St.
Chicago 12, Illinois



PATENTED

JOHN ZINK



Steamizer
MTB OIL BURNER

1. Gas or Steam Atomization of fuel oil or sludge.
2. Short flame at low excess air.
3. Low fuel oil pressure required.
4. Vertical or horizontal firing.
5. Low steam consumption.

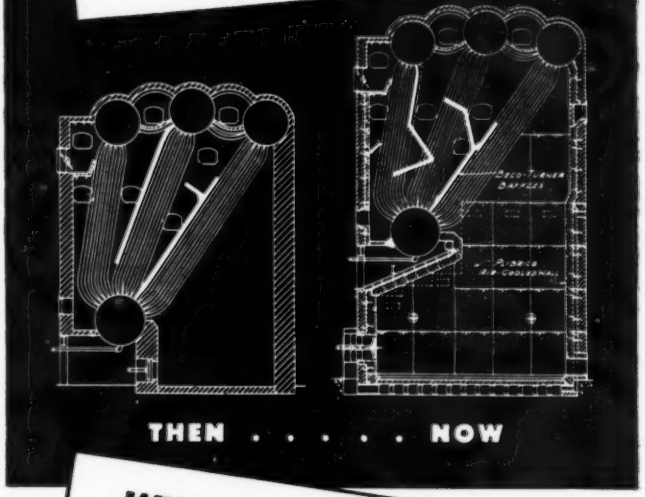
John Zink Oil Guns burn any properly prepared commercial grade of fuel oil.

Write for Bulletin

JOHN ZINK COMPANY
TULSA, OKLAHOMA

342 Madison Ave., New York, N. Y.

WHAT'S THE BEST BAFFLE DESIGN?



WHAT'S THE BEST WAY TO CARRY IT OUT?

It pays in a big way to get the right answer to those two questions . . . and if you will examine the records of Beco-Turner baffle installations you will find that we have a perfect score in answering both of these tough ones.

In the matter of design, the Beco-Turner engineering staff has covered the ground—has explored the effects of baffle design for practically every combination of boiler, furnace, and fuel-burning equipment.

And Beco-Turner construction is as far ahead as Beco-Turner design. Since Beco-Turner baffles are cast in place, there are no structural limitations calling for compromises in shape or design. Their expansion joints (an exclusive feature) keep Beco Turner baffles gas-tight.

Beco-Turner design and construction will increase the efficiency of your boilers by reducing the excess flue-gas temperatures resulting from improper design and leaky construction. Let us show you what Beco-Turner baffles can accomplish in your plant. Send blueprints or sketches of your present baffles and we will give you our recommendations without cost or obligation.

PLIBRICO JOINTLESS FIREBRICK CO.
1818 Kingsbury St. (Dept. A) Chicago 14, Illinois

EXPANSION JOINTS PREVENT CRACKS

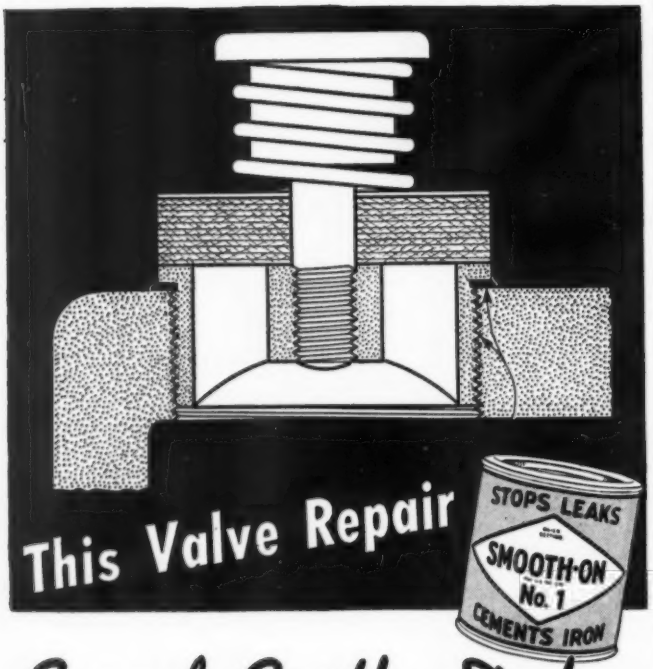
Beco Turner Baffles

Crystolon Brick for LONG LINING LIFE!

If you want uninterrupted boiler furnace operation with avoidance of costly "downtime" for lining repairs, then select CRYSTOLON Brick. These densely constructed silicon carbide brick stand up even at the highest temperatures and they are resistant to abrasion and to the penetration and erosive action of slag. CRYSTOLON Brick are not damaged by clinker removal, thus their surface remains clean and unaffected for long lining life.

NORTON COMPANY
Worcester 6, Massachusetts

Norton Longer Lasting **Refractories**



Saved Costly Delay

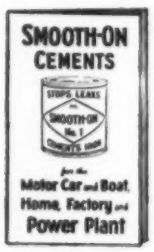
A boiler feed pump in a Philadelphia plant ceased to deliver. Inspection showed that the valve seat had become loose, worked up and down and worn out the threading.

To obtain a new oversize seat would have meant long delay. The engineer remembered Smooth-On No. 1 Iron Repair Cement. He had the worn valve seat cleaned, then reset it with Smooth-On and let it stand overnight . . . next morning the pump went back into regular service. Three years later the valve was reported still working perfectly under 125 lbs. pressure at 200°F.

Smooth-On No. 1 has been sealing cracks, stopping leaks, tightening loose parts and fixtures in mill, plants and factories for the past 50 years. A standby with engineers, mechanics and maintenance men for both emergency and routine repairs. Effective, lasting, inexpensive. Your supply house has it in 1-, 5-, 25- and 100-lb. sizes. If not, contact us.

FREE FAMOUS REPAIR HANDBOOK

Over 1,000,000 already put in circulation. Clear, concise directions for dozens of practical, tested, short-cut repairs made without heat. 40 pages. 170 diagrams. Pocket size. Just mail the coupon.



FILL OUT AND MAIL

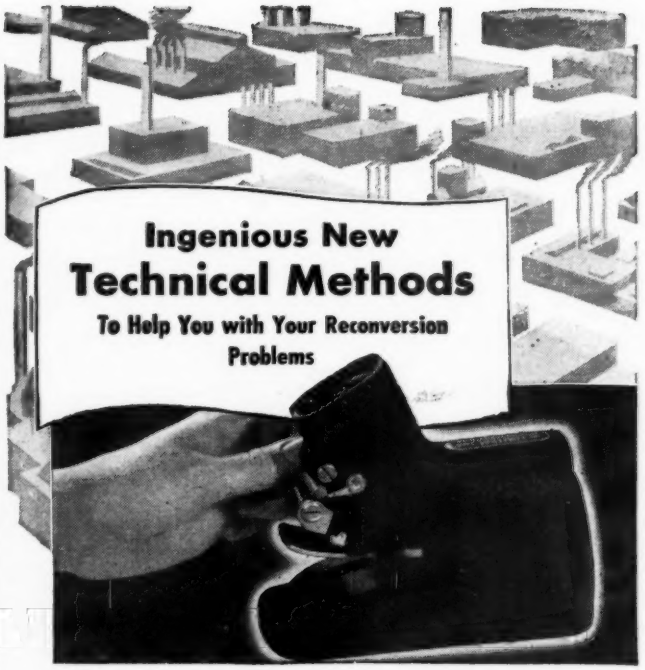
Smooth-On Manufacturing Co., Dept. 30
570 Communipaw Ave.
Jersey City 4, N. J.
Please send the FREE Smooth-On Handbook

Name .....

Address .....

1-46 .....

Do it with SMOOTH-ON



New Comparator Gage Saves Time— *Gives 6 Inspections in One!*

Even the most inexperienced operator can obtain accurate inspection of externally threaded parts, with the Limitrol Comparator Gage—in many instances, increasing the rate of inspection as much as 400%! The Limitrol, proved in hundreds of war plants, permits 6 visual checks in one: pitch diameter, lead, taper, out-of-roundness, angle, and straightness. Its use reduces inspection and production costs, cuts scrap waste while increasing speeds of operation. If a part passes the Limitrol, it will assemble accurately.

Hand Model used for "in process" gaging

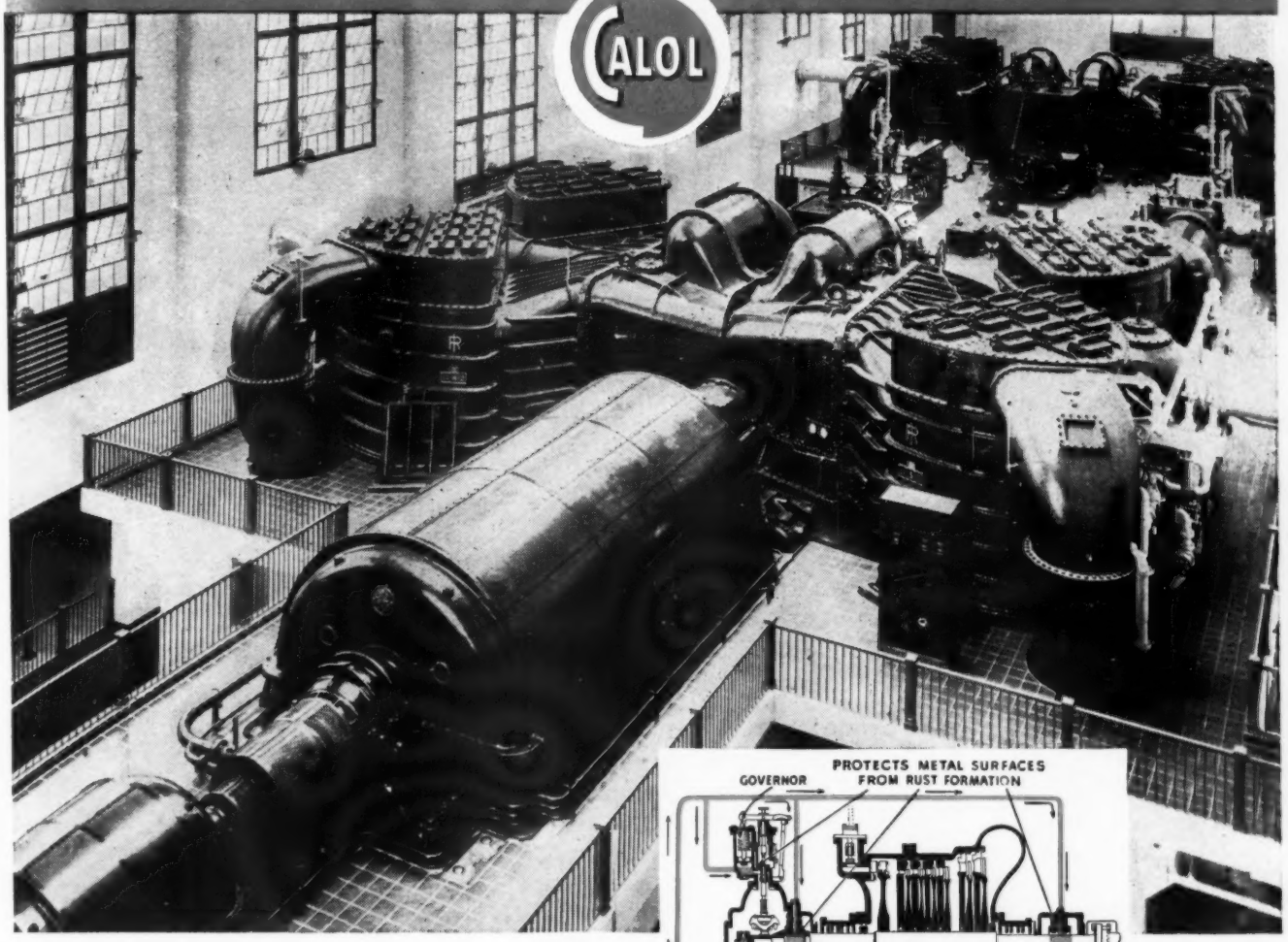
Graduated dials are furnished as standard equipment. These dials are graduated in increments which approximate .0005 inch when the magnification is 250 to 1, and serve as a guide in determining just how far over or under the limits the part might be.

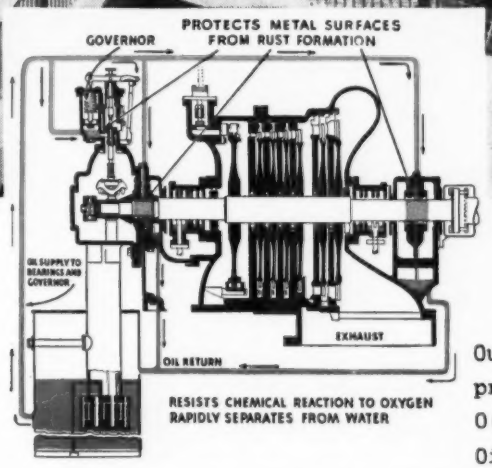
Another "help on the job" is chewing gum. Chewing seems to make work go easier, time go faster. Good chewing gum is available, but there's still a shortage. That's why we at Wrigley wish we could make Wrigley's Spearmint now, to help increase the available supply. You may be sure we will, just as soon as sugar restrictions are lifted. Meanwhile, chew any good available brand, because it's the chewing that really does you good.

You can get complete information from N. A. Woodsworth Co., Sales Division, 1300 E. Nine Mile Road, Detroit 20, Mich.

AA-52

Major power company picks Calol Turbine Oils





Southern California Edison Company, one of the largest producers and distributors of electric power in the country, has been using Calol Turbine Oils in steam turbines installed in the No. 3 Plant of its Long Beach Steam Station, for the past sixteen years.

The rapid expansion of industry has resulted in the installation of larger and improved turbines by such concerns as Southern California Edison. Keeping pace with these developments, Standard of California has constantly improved its lubricants to meet the requirements of modern equipment.

Our new improved Calol OC Turbine Oils are outstanding examples of this progressiveness. These unusual oils contain an oxidation inhibitor and a corrosion inhibitor. They eliminate rusting and provide economical, gum and sludge-trouble-free lubrication in the toughest kind of service.

There is a proper grade of Calol OC Turbine Oil for every condition of turbine lubrication. This oil, in every grade, meets the exacting specifications of the leading turbine manufacturers.

For additional information and the name of your nearest Distributor, write Standard of California, 225 Bush Street, San Francisco 20, Calif., or California Commercial Company, 30 Rockefeller Plaza, New York 20, N. Y.

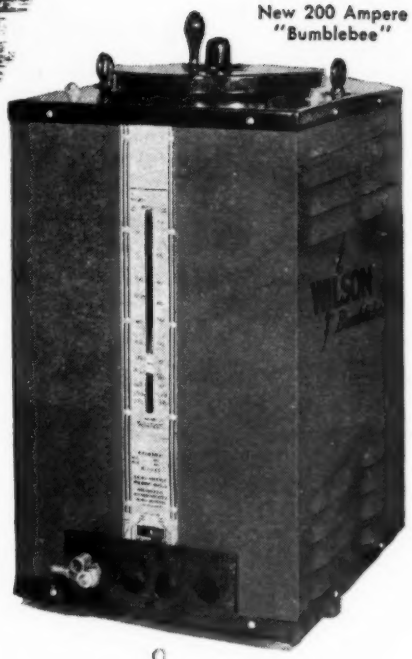
FOR EVERY JOB A STANDARD OF CALIFORNIA TEST-PROVED PRODUCT

NOW YOU CAN HAVE

"Bumblebee" performance

for every welding job

New 200 Ampere "Bumblebee"



WHATEVER your welding problem — on production lines, or special jobs — there's a Wilson "Bumblebee" A.C. Arc Welder that's just suited to your needs . . . designed to do the work faster, better, with lower power consumption.

"Bumblebees" are now made in five sizes, all embodying characteristic "Bumblebee" efficiency, economy and dependability: (1) The new 200 ampere "Bumblebee" for light, odd-job or production welding; (2) the 300 ampere, and (3) the 500 ampere "Bumblebee" for heavy all-purpose assignments; and (4 and 5) the 750 and 1000 ampere sizes available on special order. The 300 and 500 ampere sizes are available in "All-Weather" models for welding under conditions where excessive moisture is encountered.

Throughout industry the many important features of the "Bumblebee" have made them a widespread choice among owners and operators. With their deep penetrating arc and excellent arc characteristics, they permit more welding production per work day — of better quality, with considerably lower power costs.

Light, well balanced, rugged, they provide continuous, step-less current control, from maximum to minimum — simply by turning a crank on top. All "live" parts are completely shielded and protected.

All-Weather Model 300 and 500 Ampere Sizes

• **See your nearest Airco office for full information or write Dept. P for catalog ADW-53A. Address Air Reduction, General Offices: 60 East 42nd Street, New York 17, N.Y. In Texas, Magnolia Airco Gas Products Co., General Offices: Houston, 1, Texas. Represented Internationally by Airco Export Corporation.**

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WILSON

"Bumblebee"

A.C. **ARC WELDERS**

with the penetrating, stinging arc

A COMPLETE LINE OF A.C., D.C. AND GAS-ENGINE DRIVEN UNITS

"More headroom" with SUPER-SILVERTOPS

● Many users of Anderson Super-Silvertops have commented on the advantages of "more headroom"—another advantage of having the U-tube inside the trap case. The saving in headroom of from 3 to 6 inches is a lot, if the ceiling or installation gets down close to head-level. On floor installation this feature is not so important, but on unit heaters and other overhead uses, it is appreciated.

Super-Silvertop piped straight-in-line or as an elbow needs but one fitting.

On any installation, simplified piping with Anderson Super-Silvertops saves fittings and labor. On every installation, you get maximum heat and long, trouble-free trap life. Find out all about it; get your copy of "How to Choose a Steam Trap" . . . This helpful book tells where, when and why to use steam traps, what size, what type and in what way to install them. It shows how Anderson Super-Silvertops are constructed and points out the savings. Ask for your copy —it's free!

THE V. D. ANDERSON COMPANY
1934 W. 96th Street · Cleveland 2, Ohio

Super-Silvertop
STEAM TRAPS

BOILERS "SNAP OUT OF IT!"

MARION SOOT BLOWERS modernize boilers right now! They do this work:

- Increase boiler capacity and flexibility
- Save 5 to 10 percent on fuel bills
- Do the job mechanically and quickly
- Blow out soot deposits without injury to baffles

● Soot slows boilers down. *MARION SOOT BLOWERS* eliminate stubborn soot with minimum waste of steam. Type "F" for water tube boilers blows in any length of arc from 15 to 345 degrees. No lugs, stops, pawls, nor pins. "Keeps on Rollin' " to right or left as desired. Favorites with skilled engineers and power plant owners, *MARION SOOT BLOWERS* are made for all sizes and types of boilers. Parts are interchangeable. Continuous service with low replacement and repair cost.

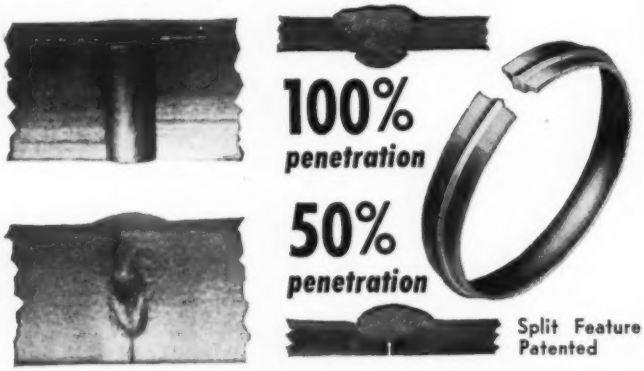
Write for Specifications and Prices
Save Coal, Time and Worry

THE MARION LINE

Marion Machine, Foundry and Supply Co. • Marion, Indiana, U. S. A.

Use WEDGE Split CHILL RINGS for STRONGER Joints to meet SHOCK STRAIN or VIBRATION

Most pipe failures occur at the joints. In many Power Plants WEDGE Chill Rings with the patented SPLIT Feature are used for welding joints because they produce STRONGER joints. In fact the joints are the strongest part of the line and in case of shock, strain or vibration the pipe will fail before the reinforced joints. Many have found that joining pipe by welding, using WEDGE Chill Rings, is the best and most economical way.



Write for circular and prices

WEDGE PROTECTORS, INC.
9524 Richmond Ave. Cleveland 5, Ohio

WEDGE CHILL RINGS SAVE MONEY

PRODUCTION *for* PEACE

A year of remarkable history has just passed, in which the normal routine way of living for most every individual in many countries of the world, was disturbed. Citizens everywhere were devoting their energies to war—to destroy, instead of to build.

and NOW *it is* 1946

REG. U.S. PAT. OFF.

INDUSTRIAL Rubber Products that Quaker is making NOW for civilian use
(PARTIAL LIST ONLY)

- Transmission Belting
- Agricultural Belting
- Conveyor Belting
- Elevator Belting
- Air Drill Hose
- Chemical Hose
- Creamery Hose
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- Gasoline Hose
- Tank Car and Tank Truck Hose
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- Spray Hose
- Steam Hose
- Suction Hose
- Oil Suction and Discharge Hose
- Water Hose
- Road Contractors' Hose
- Welding Hose
- Tubing
- Rod Packings
- Sheet Packings
- Gaskets
- Washers
- Pump Valves
- Moulded Articles

1946 starts out with a fresh inspiration to guide us in peacetime endeavors. Quaker had no reconversion problem. The products of Industrial Rubber Goods which we manufacture are very similar, whether used for war industries or for peace industries. The paper work on cancellations of Government orders is just about completed. Full scale production on civilian orders started August 17th and has been going on steadily ever since.

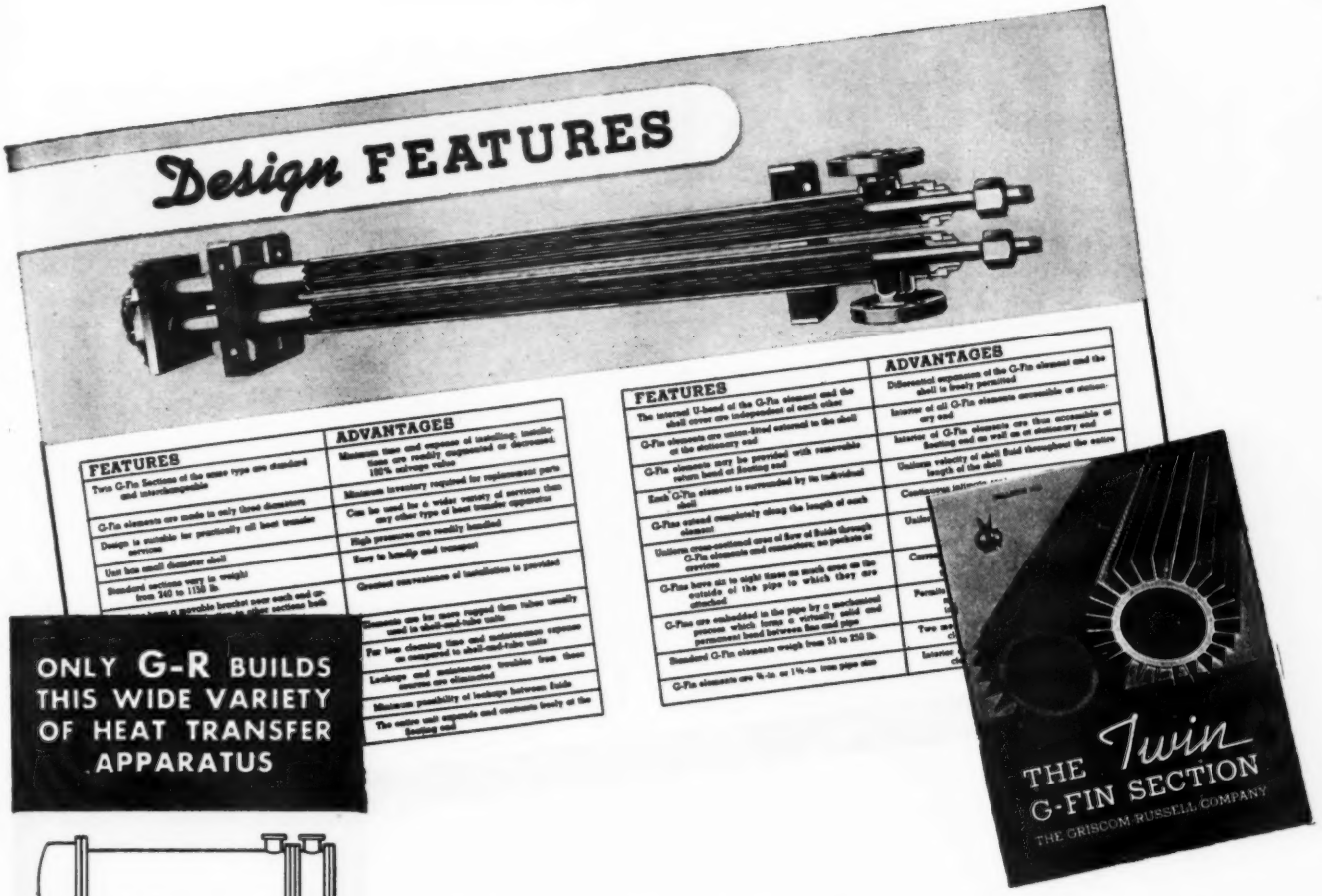
Naturally we are making headway on our backlog of orders. It still will be several months before critical raw materials will be available in quantities wanted. But we are making better deliveries on many items, especially on Fire Hose, Mill Hose and in Wrapped Construction Hose in sizes 3" and larger.

Our suggestion to the keen buyers, with an eye on the future, is to place their orders well in advance of requirements. This will insure getting your merchandise when desired.

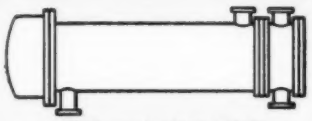
Anticipate your needs on Industrial Rubber Products and send your orders to Quaker NOW.

If there is a way to get it done
QUAKER *will do it*

QUAKER RUBBER CORPORATION
Mfrs. Industrial Rubber Products
PHILADELPHIA 24, PENNSYLVANIA
NEW YORK • CLEVELAND • CHICAGO • HOUSTON
Western Territory
Quaker Pacific Rubber Company
San Francisco • Los Angeles



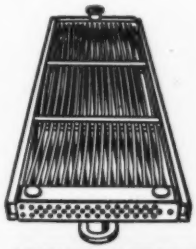
ONLY G-R BUILDS THIS WIDE VARIETY OF HEAT TRANSFER APPARATUS



SHELL and BARE TUBE
Heaters, Coolers, Condensers, Heat Exchangers

G-FIN
Longitudinal-finned elements for greater heat conductivity

K-FIN
Helical-finned elements for vapors and gases



BENTUBE SECTIONS
with scale-shedding elements for hard or salt water

TUBEFLO SECTIONS
Non-clogging design for residuum and other dirty fluids

THE MOST WIDELY USED HEAT TRANSFER APPARATUS!

This is a broad statement to make, but it is backed up by the fact that more than 40,000 Twin G-Fin Sections are being used by over 800 concerns for a greater variety of services than any other design of heat transfer unit.

Why? . . .

21 Features are responsible for this remarkable success of the Twin G-Fin Section. To mention only a few: great adaptability, interchangeability, freedom from leakage, sturdiness, convenience of handling, ease of cleaning, low maintenance expense. You'll find a detailed description of the Twin G-Fin Section—showing *all* its features and advantages—in our Bulletin 1613. Send for it today!

THE GRISCOM-RUSSELL CO.
285 Madison Ave., New York 17, N. Y.

GRISCOM-RUSSELL
TWIN G-FIN SECTION
The Universal Heat Exchanger

HOPPES
FEEDWATER HEATERS

Deaerating and Non-Deaerating

Write for Bulletin

THE HOPPES MFG. CO.

Established 1881

SPRINGFIELD **OHIO**

TOUGH OVERLAYS *and* PATCHES *for* Concrete or Wood Floors

Resurface or patch broken concrete floors with tough RUGGEDWEAR resurfacer. Here's a material which will stand up under the most punishing traffic conditions. Simple to install—no chopping or chipping required. Merely sweep out the spot to be repaired—mix the material—trowel it on. Holds solid and tight right up to irregular edge of old concrete. Provides a firmer, tougher, smoother, more rugged wearing surface. Used indoors or out. Dries fast.

MAIL COUPON for FREE TRAIL OFFER

FLEXROCK COMPANY
3677 Filbert St., Philadelphia 4, Pa.

Please send me complete RUGGEDWEAR information and details of FREE TRIAL OFFER—no obligation.

Name .....

Company .....

Address .....

Mr. Fillet Weld WINS *on* ~~IN~~ A WALKWAY

• When it comes to running a walkway, Mr. Fillet Weld is a winner every time. That's what makes **BATES • GRATES** the right choice for walkways and open steel flooring in your plant.

These championship qualities go into BATES • GRATES

- **Longer lasting**—the Fillet Weld and Hex Bar construction makes **BATES • GRATES** more durable. Their strength exceeds all former standards set for open steel flooring and stair treads.
- **Safer**—the combination of Hex Bars and Fillet Welding provides clean, crisp, SAFE grating.
- **Better ventilation and light**—the reflecting bevels of the Hex Bars, with 90° corners, allow maximum transmission of light and air.

for open steel flooring, stair treads, floor armor and bridge decking . . .
Get a Bid from BATES

ENGINEERING PROGRESS REPORT #1

LJUNGSTROM AIR PREHEATER

The Cold End of the Boiler

In the desire to recapture as much as is possible of the heat that has heretofore been wasted, attention is focused on reduction of temperature of gases from the boiler entering the stack. It is well known that all fuels contain sulphur and the amount of this sulphur has a very direct effect upon all parts of the units which it contacts. These objectionable features in the fuel cause the following:

1. Deposits are formed because of the presence of sulphur in the fuel, and the amount of deposit formation and corrosion rises with the sulphur content.

2. The action of sulphur is to corrode the iron and form iron sulphate, which is hygroscopic and becomes moist and adhesive. This, in turn, collects fly ash from the flue gas, forming an acidic and progressively corrosive paste.

HOW THE LJUNGSTROM IS MEETING THESE CONDITIONS:

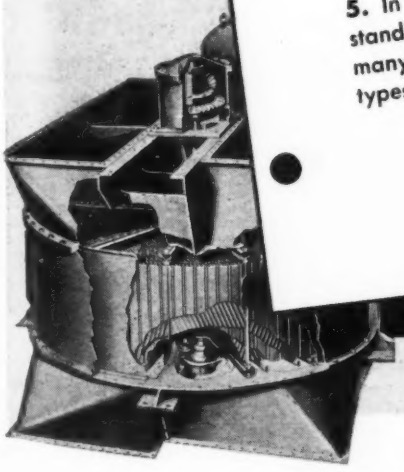
1. At the present time, the simplest method of minimizing damage from this corrosive deposit is to remove it at frequent intervals by mechanical force. This is best done by a jet of high-velocity steam or air applied directly to the deposits. Deposits form at the cold end of the heating element, and the jet of air or steam is more effective when applied at this end.

2. Best cleaning results from application of the mass soot blower in the entering air chamber, with the blow in the direction of the flow of air through the preheater.

3. Generous size glass observation ports in combination with adequate internal illumination aids in determining when the surface needs cleaning and when the cleaning is complete.

4. With sufficient pressures of air or steam, it is possible to clean the elements so that draft loss is maintained at normal levels, even with high-sulphur-content fuels. This can be done while the preheater is in full operation.

5. In view of the fact that all plants have their peculiarities, either from the standpoint of fuel or method of operation, judgment must be used in applying many of these observations, made through the entire range of fuels and many types of installations.



THE

AIR PREHEATER

CORPORATION

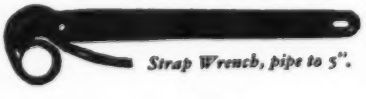
Executive Offices: 60 East 42nd Street, New York 17, N. Y. • Plant: Wellsville, N. Y.

More Service... Less Upkeep

UNCONDITIONAL GUARANTEE
If this Housing ever Breaks or Distorts we will replace it Free
COPR 1937 THE RIDGE TOOL CO. ELYRIA, O.

when you use the Guaranteed RIGID Heavy-Duty Pipe Wrench

● It looks different—but the real difference is in its performance. The housing simply won't break or warp—no bother or expense of repairs. Full-floating hookjaw (with handy pipe scale) and replaceable heeljaw take hold instantly, won't lock on pipe. Adjusting nut in open housing spins to pipe size. Powerful comfort-grip I-beam handle eases hard pulls. Ask your Supply House for the rugged work-saver RIGID. We're manufacturing more of them than ever, but it's not enough—please be patient.

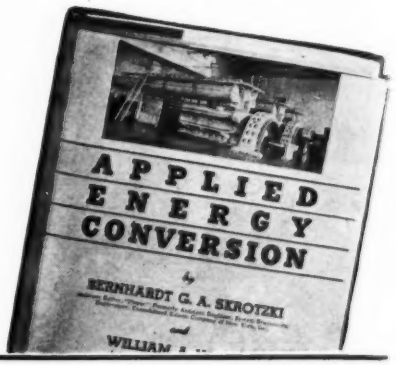

Strap Wrench, pipe to 5".

RIGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY · ELYRIA, OHIO, U. S. A.

Showing you

- **FACTS on characteristics and performance of modern power plant equipment**
- **FIGURES on how to keep plant costs down**

See it 10 days on approval



This manual will help you in selecting the power plant equipment most suited to your needs, will guide you in its operation, assure you of the most economical power usage, show you how to operate so that costs will be kept at a minimum, power efficiency at a maximum. 509 pages of practical descriptions cover fuel-fired steam plants, internal-combusion engine plants, hydraulic plants, the new development of the gas turbines and wind turbines, special and European types of steam generators. The practical survey of costs covers investment charges or fixed charges, annual operating costs, methods of economic selection, guides you in achieving the desired ratio of cost to power output.

Just published!

APPLIED ENERGY CONVERSION

A Text in Power Plant Engineering

By BERNHARDT G. A. SKROTZKI

Assistant Editor, Power; formerly Assistant Engineer, System Engineering Department, Consolidated Edison Company of New York, Inc.

and WILLIAM A. VOPAT

Assistant Professor of Mechanical Engineering, The Cooper Union School of Engineering

509 pages, 5¾ x 8¼, 255 figures & tables, $5.00

Here is a reference source you can turn to for the answer to every type of problem—a practical manual combining a complete analysis of the functions and operating principles of the major energy conversion equipment used commercially, with a careful consideration of the economic aspects of power equipment selection and operation.

Use it for the facts you want on:

- —Fuel purchasing
- —removal of flue gas solids
- —turbine lubrication
- —considerations of plant selection
- —feed-water regulation
- —power plant piping systems
- —diesel engine types and specifications
- —hydraulic plant turbine performance
- —special steam generation developments
- —the combustion gas turbine
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Send me Skrotzki and Vopat's **Applied Energy Conversion** for 10 days examination on approval. In 10 days I will send $5.00, plus few cents postage, or return book postpaid. (Postage paid on cash orders).

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Case History Shows:

33⅓% More Steam Output

Enco Streamlined Baffles Can Help You, Too.

A recent engineering service report on the efficiency of a large steel plant boiler uncovered this striking fact . . . **Enco Streamlined Baffles boosted steam output 33⅓%.**

Before the Streamlined Baffles were installed, the boiler had difficulty in producing 60,000 pounds of steam an hour. Now, according to the company's chief engineer, "We have no difficulty in obtaining an output of 80,000 to 85,000 pounds of steam an hour."

This is no miracle. Enco Streamlined Baffles are designed to maintain a cross-flow of gases across the tube banks. They are smoothly curved to insure a uniform, high-velocity gas flow over every square foot of heating surface. Bottle-necks, dead gas areas, soot pockets are eliminated; draft-loss is cut to a minimum. The result — more efficient, economical heat transfer.

Especially engineered to suit each particular boiler design, and installed by experience-trained Enco crews, Enco Streamlined Baffles provide for easy tube replacement, low maintenance cost, adaptability to bent tube boilers. You can expect a higher efficiency from your boiler — a substantial increase in steam production — by installing Enco Streamlined Baffles. Call or write for the 18-page Enco Bulletin — BW-44. There's no obligation.

THE ENGINEER COMPANY ALSO PRODUCES:

Enco Oil Burners — Steam or Mechanical Atomizing Types.
Enco Air Registers.
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EC - 461

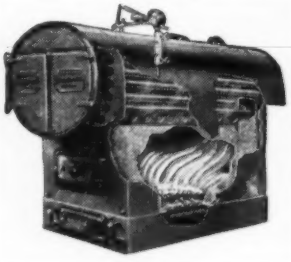
TAPERED LEGS

There's a big improvement in the action of boilers equipped with tapered water legs developed by Brownell many years ago. These legs are used in Brownell firebox boilers—single, double, and triple pass.

The taper in the water legs gives room for the volume increase of water as it expands and rises. This provides much faster circulation and facilitates heat transfer; also prevents fluctuating water line by eliminating the surging which would otherwise be caused by locked-up vapor in the legs.

In Brownell boilers you get the benefit of Brownell's 90 years of boiler-making experience and engineering. Ask for literature and name of nearest agent.

THE
BROWNELL
CO.
306 N. FINDLAY ST.,
DAYTON 1, OHIO



Sectional View of Brownell Standard Boiler Showing Tapered Water Legs

YOU GET ALL 3

***When* NAZARETH STEEL**
fabricates your job . . .

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★ **ECONOMICAL PRICES**
★ **DEPENDABLE SERVICE**

NO JOB TOO LARGE or too small!

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We welcome your inquiry on any Steel Plate Fabrication problem. Simply call or write NSF today. No obligation whatsoever. Write for Descriptive Folder.

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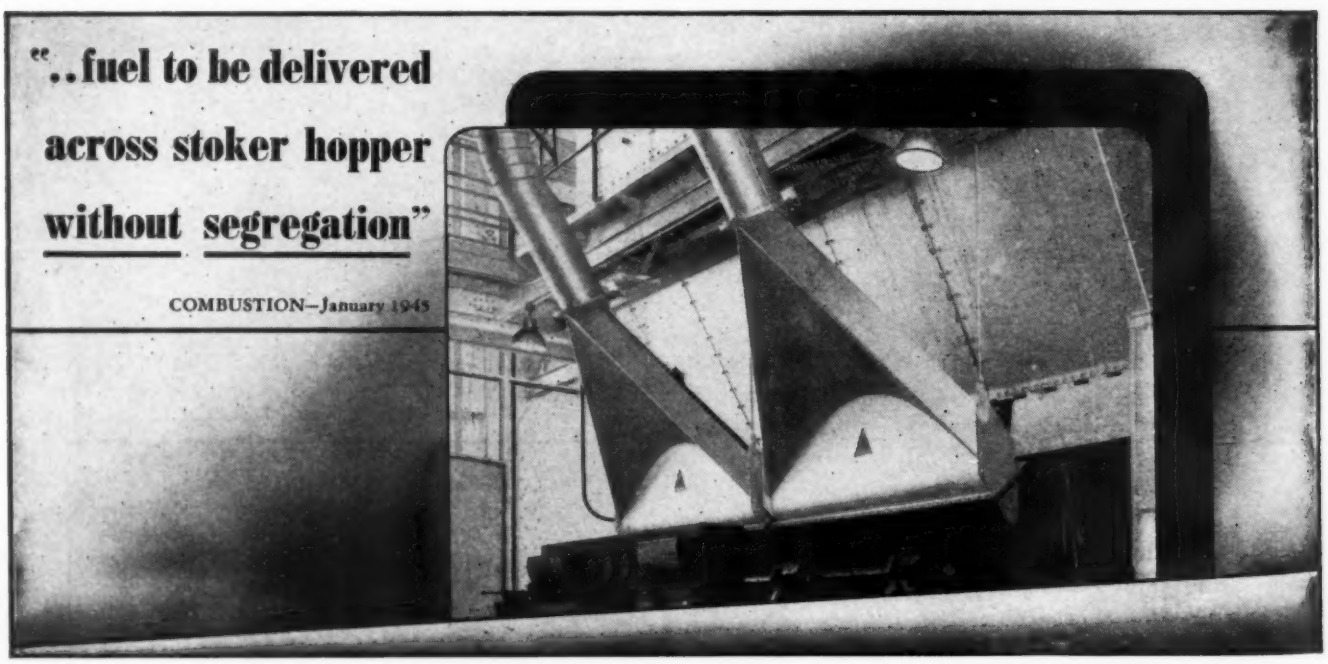
STEEL PLATE CONSTRUCTION . . ENGINEERING . .
LIGHT STRUCTURAL STEEL . . SCREW CONVEYORS

"..fuel to be delivered across stoker hopper without segregation"

COMBUSTION—January 1945



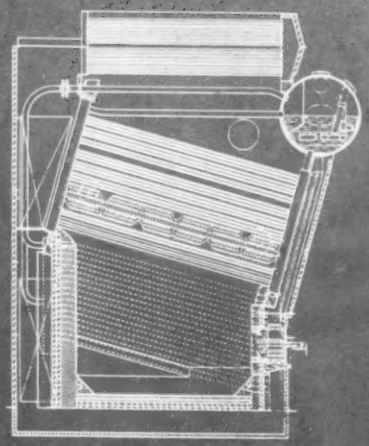
This quote, taken from an article on coal sizing, published recently in COMBUSTION, was listed as a "must" for the efficient burning of coal on stokers. To avoid segregation in your coal feeding system install CONICAL Non-Segregating Coal Distributors as made by S. E. Co. Their design is based on sound scientific principle and *they will eliminate segregation.* Write for full details. Address—Stock Engineering Co., 715 Hanna Bldg., Cleveland 15, Ohio

STOCK
ENGINEERING CO.
S.E.Co. Coal Valves and Coal Scales, CONICAL Non-Segregating Coal Distributors

is YOUR Boiler-Water Treatment Complete?

No. 1 *in a series of advertisements on the requirements for the COMPLETE conditioning of boiler water.*

here's what COMPLETE boiler-water treatment MUST include:



1. SOUND CHEMICAL TREATMENT
2. A GOOD ORGANIC COAGULANT
3. SIMPLE BUT SCIENTIFIC CONTROL
4. COMPETENT SERVICE and INSTRUCTION

The most able engineer cannot be expected to know all the "ins and outs" of Boiler-Water Chemistry — but any engineer can make certain that boilers are free from scale, corrosion, wet steam and waste by using a system of boiler-water conditioning that meets THESE FOUR fundamental requirements.

Settle down to sound operation with AMEROID — the COMPLETE Boiler-Water Treatment.

Incomplete boiler-water treatment can be VERY costly . . . if you are not sure that your system of boiler-water treatment is COMPLETE, talk it over with the DREW Man—there's no obligation!

AMEROID

The COMPLETE Boiler-Water Treatment

E. F. DREW & CO., Inc.

15 East 26th Street, New York 10, N. Y.

Representatives in Key Cities in United States and Canada

How much does a Fuse Blowout cost YOU?

Investigate STAR Renewable Fuses!

PROTECTION *plus* SERVICE. Prevent time-wasting work stoppages.

Loose contacts in your fuses mean costly delays when fuses fail to carry their rated loads.

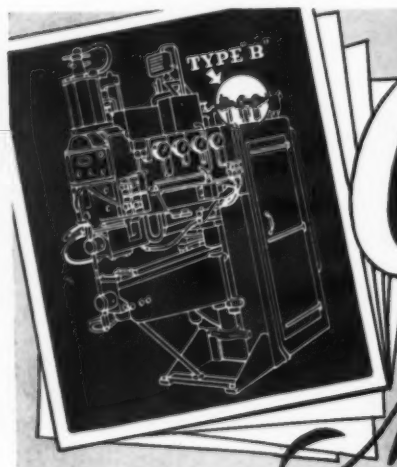
STAR RENEWABLE FUSES

have:
- Spring contacts
- No screws, nuts
- Separately enclosed refills

Doubling up of refills prevented.
All sizes can be assembled without tools.
Approved by National Board of Underwriters.

Serving Satisfied Users for over 30 years

STAR FUSE CO., 239 Canal St., New York 13, N.Y.



One of Many

PRACTICAL INDUSTRIAL APPLICATIONS of CASH-ACME PRESSURE CONTROLS

Write today for your copy of our 28 page Catalog showing in detail how this and other CASH-ACME products can best serve you.

An Automatic VALVES its THIS name that counts

CASH-ACME

A.W. CASH VALVE MFG. CORP.
6662 EAST WABASH AVE.
DECATUR ILLINOIS

Boiler Tubes

ANY SIZE—BENT OR STRAIGHT

This organization has the experience and facilities to meet your most exacting requirements. We can promise quick delivery on precision work, guaranteeing accuracy as to length and bend. Why not send that next order to "Boiler Tube?"

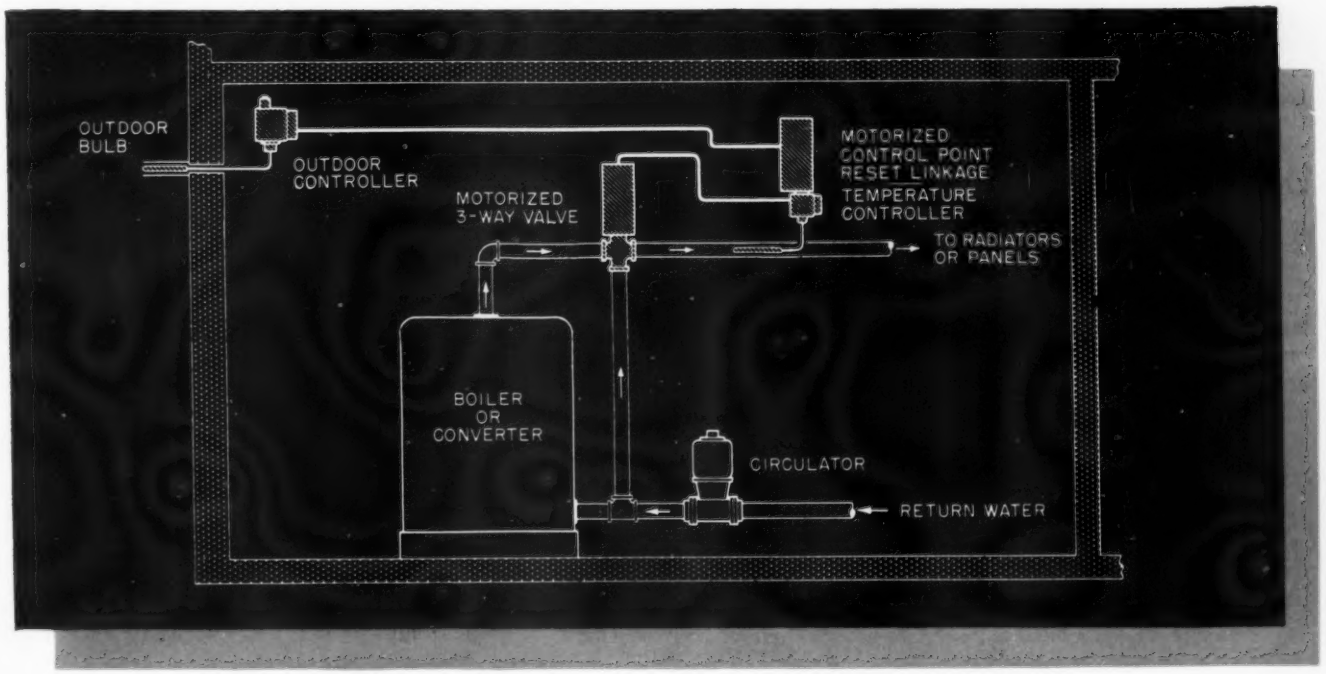
BOILER TUBE CO. OF AMERICA

Preble Ave. & Edgerley St., N. S.,
PITTSBURGH, PA.

PITTSBURGH • NEW YORK • CHICAGO
FRED S. RENAULD & CO., LOS ANGELES

Now Available

MODULATED BOILER CAPACITY TO MATCH OUTDOOR WEATHER



This new Honeywell motorized reset temperature control system automatically (1) reduces the supply water temperature in mild weather which prevents waste fuel and the discomfort of overheating, and (2) increases the supply water temperature in cold weather to give quick pressure response to heating demands.

The system, which has been designed for commercial buildings, provides a continuous flow of radiated heat inside, tempered in accordance with outside weather demands. Surrounding boiler room temperature or mechanical friction cannot affect the system, as the powerful all-electric modulating controls which have successfully been used in commercial heating and air conditioning are the basis of the motor operation.

Investigate this new Honeywell motorized reset temperature control system, which not only produces more even and healthful heat but saves fuel as well. This modern equipment is available for all types of automatic burners on hot water or split systems and for single or multiple zone systems. Minneapolis-Honeywell Regulator Co., 2706 Fourth Avenue So., Minneapolis 8, Minn.

MINNEAPOLIS **Honeywell**
CONTROL SYSTEMS

The GUESS IS OUT WHEN YOU MEASURE YOUR VALUABLE STORED LIQUIDS With LIQUIDOMETER Tank Gauges

WRITE for COMPLETE DETAILS

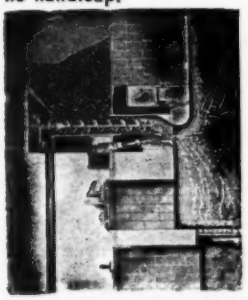
"LIQUIDS WORTH STORING ARE WORTH MEASURING"

THE LIQUIDOMETER CORP.
39-16 SKILLMAN AVE., LONG ISLAND CITY, L.N.Y.

FYR-FEEDER MULTIPLE SPREADER STOKERS

BURN COAL LIKE OIL!

Save with Fyr-Feeder — Burn less Coal — Cheaper coal — Local coals — Screenings — Coal yard sweepings, wet or dry — Wet Coal is no handicap.



FYR-FEEDER
exclusively uses
Air JET Coal PROPULSION

Fines burn in suspension, larger pieces are spread evenly over grates.
Fyr-Feeder increases boiler capacity — responds instantly to sudden load variations—requires no special skill or experience to operate—thin fuel bed eliminates clinkers—makes firemen's work much easier —no banking losses.

CHANGE OVER TO FYR-FEEDER NOW!
Easily installed in minimum time.

Fyr-Feeders are built in sizes to burn from 300 to 1200 lbs. of coal per hour. If you are or expect to be in the market for automatic coal burning equipment.

Wire or Write
FYR-FEEDER Stoker Division
AMERICAN COAL BURNER COMPANY
Engineers

32-18 E. Erie St. Chicago 11, Ill.

WIEDEKE IDEAL TOOLS
are foremost in Tube Expanders

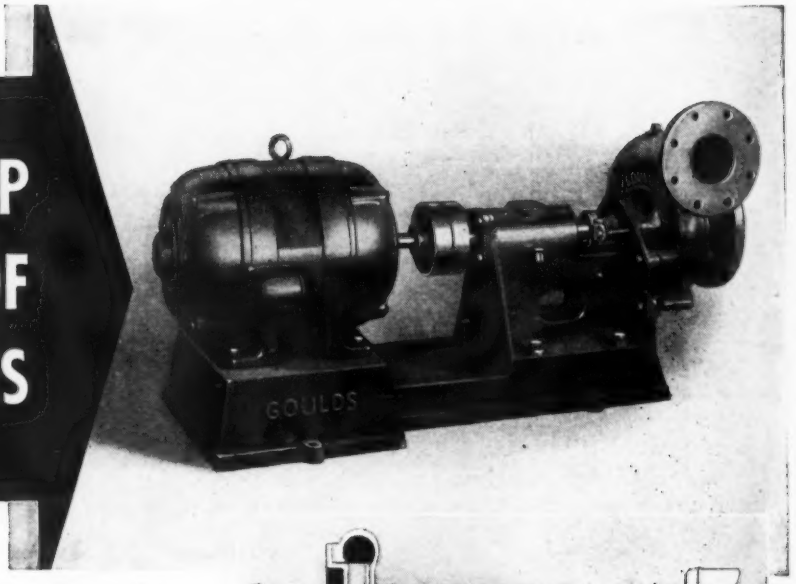
SERIES NO. 1500
IDEAL ROLLER
TUBE EXPANDERS

The Wiedeke Ideal Tube Expanders are used by Boiler Erectors and Repairmen for rolling and flaring Heavy Wall Tubes in most types of Modern Water Tube Boilers, Economizers, Superheaters and Water Walls.

Our IDEAL BULLETIN NO. 65 illustrates and explains how these Ideal Tube Expanders are used to roll tubes in Drums, reaching through Headers, also within Headers. Tables are shown to enable correct selection of suitable Ideal Tube Expanders for different inside diameter of tubes and different sheet or wall thickness of Drums.

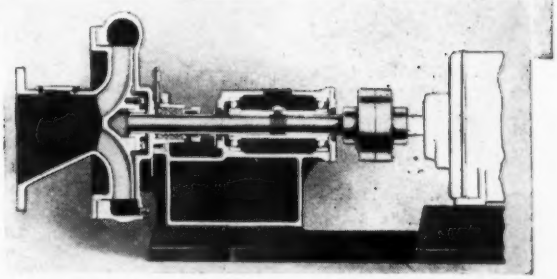
The Gustav Wiedeke Company
DAYTON 1, OHIO · U.S.A.

HERE IS A PUMP FOR A VARIETY OF INDUSTRIAL USES



Goulds "FLEXI-UNIT" Centrifugal Pump

ADAPTABLE FOR WATER, FACTORY WASTES, LIQUORS, OILS, VISCOUS OR CORROSIVE LIQUIDS



Top: Goulds Flexi-Unit Centrifugal Pump—Figs. 3157-58-double bearing type.

Above: Goulds "Flexi-Unit" centrifugals are readily accessible for maintenance. Removal of suction cover permits impeller adjustment. Impeller bolted to shaft flange for quick dismantling. Shaft is supported by two heavy-duty ball bearings amply spaced to take both radial and thrust loads. Stuffing box is extra deep to provide for ample packing with one piece, non-scoring throat bushing and sealing ring and with bolted gland. Special sealing arrangements are used for handling liquids containing foreign matter.

Of the various types of centrifugal pumps Goulds manufactures, the "Flexi-Unit" is used for a greater variety of services than most. Sturdily built, they range in size from 1" to 4" and in capacities from 10 to 1000 G.P.M. They will handle heads up to 280 ft. Various constructions and refinements further increase their adaptability. Note the special features opposite.

If your particular pumping requirements necessitate other types of centrifugal, rotary or reciprocating pumps, send your data to Goulds engineers. They will help you select the pump exactly suited for the job. Capacity head and H.P. will reflect maximum efficiency with maximum economy. There is no better way to start 1946 operations than to get the right pump for each job. Goulds will start you right!

Closeup of special warped vane impeller with round nose (two or three vanes) handles thin or thick liquids efficiently.

Features of Goulds "FLEXI-UNIT" *Centrifugal Pumps*

(Single-stage, side suction, double ball bearing)

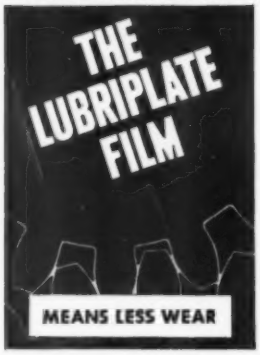
1. Top horizontal discharge eliminates air binding in casing and results in quiet running pump with no loss of capacity or head... especially important when pumping hot or volatile liquids.
2. Open-type impeller with special warped vane and round nose will handle viscous liquids or liquids containing fibrous material.
3. When used for pumping corrosives, the casing, suction cover, impeller and shaft can be furnished in metals most suitable for service. As casing and bearing support is separate and not in contact with liquid, the support can be made of cast iron, thus reducing cost of pumps for special services.

Goulds PUMPS, INC.

SENECA FALLS, N.Y.

the PUMP FOR the JOB

LUBRICATION IS INDUSTRY'S PRIME ESSENTIAL



The enormous production of the past several years has not only proven the importance of proper lubrication, but has effectively demonstrated the superiority of LUBRIPLATE Lubricants. Even the most confirmed skeptic must admit that when two surfaces do not touch, there can be no appreciable wear. The separating film of LUBRIPLATE is tougher. That is why LUBRIPLATE Lubricants impart longer life to shafts, bearings and gears. LUBRIPLATE has qualities not possessed by conventional lubricants.

. . . Write for a booklet, "The LUBRIPLATE Film" written especially for your industry.

The Genuine for accessibility

Squires

Removal of two bolts frees the top cap—and the valve and seat are completely exposed to view.

The accessible Squires has become a byword among power plant operators.

Reliability and economy are among its popular points and besides Squires Traps positively will not wire draw.

The C. E. Squires Co.
E. 40th St. and Kelly Ave.
Cleveland 3, Ohio

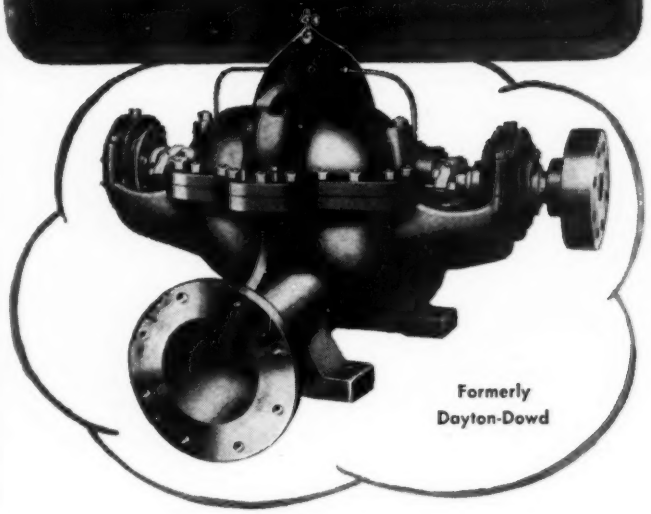
TRADE MARK
Reg. U. S. Pat. Office

May we send you Catalog A-9

Continuous Duty

HORIZONTAL PUMPS

Precision-built by Peerless



Peerless (formerly Dayton-Dowd) Horizontal Centrifugal split case or solid volute pumps, single and multi-stage are found wherever reliability, dependability and economical operating costs are desired. Engineered and manufactured with a view to long life, Peerless Pumps are available for all classes of pumping requirements.

PEERLESS PUMPS

HORIZONTAL PUMPS FOR:	VERTICAL PUMP TYPES:
Water Towers	Deep Well Turbine
Boosters	Hi-Lift (Moyno Type)
Fire Protection	Centrifugal
Boiler Feed	Sewage
Condensate	Jet
Sewage	Shallow Well
Chemicals	Hydro-Foil (propeller)

The right pump for the right job. All inquiries and specifications processed by trained engineers.

Ask for name of Distributor nearest you.

PEERLESS PUMPS

PEERLESS PUMP DIVISION
Food Machinery Corp.

FACTORIES
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WHATEVER your need . . . whenever you need it, your Industrial Supply Specialist will bring you the products and materials you require to keep production rolling. When power transmission is your problem, your Industrial Supply Specialist will recommend Hewitt Transmission Belting. All types have been Job-Engineered in a full range of plies and sizes required to keep the machinery of production turning. Three famous brands, Monarch, Ajax and Conservo, supply every need. Your Industrial Supply Specialist will show you how Hewitt Job-Engineered Transmission Belting can decrease maintenance costs and increase power transmission.

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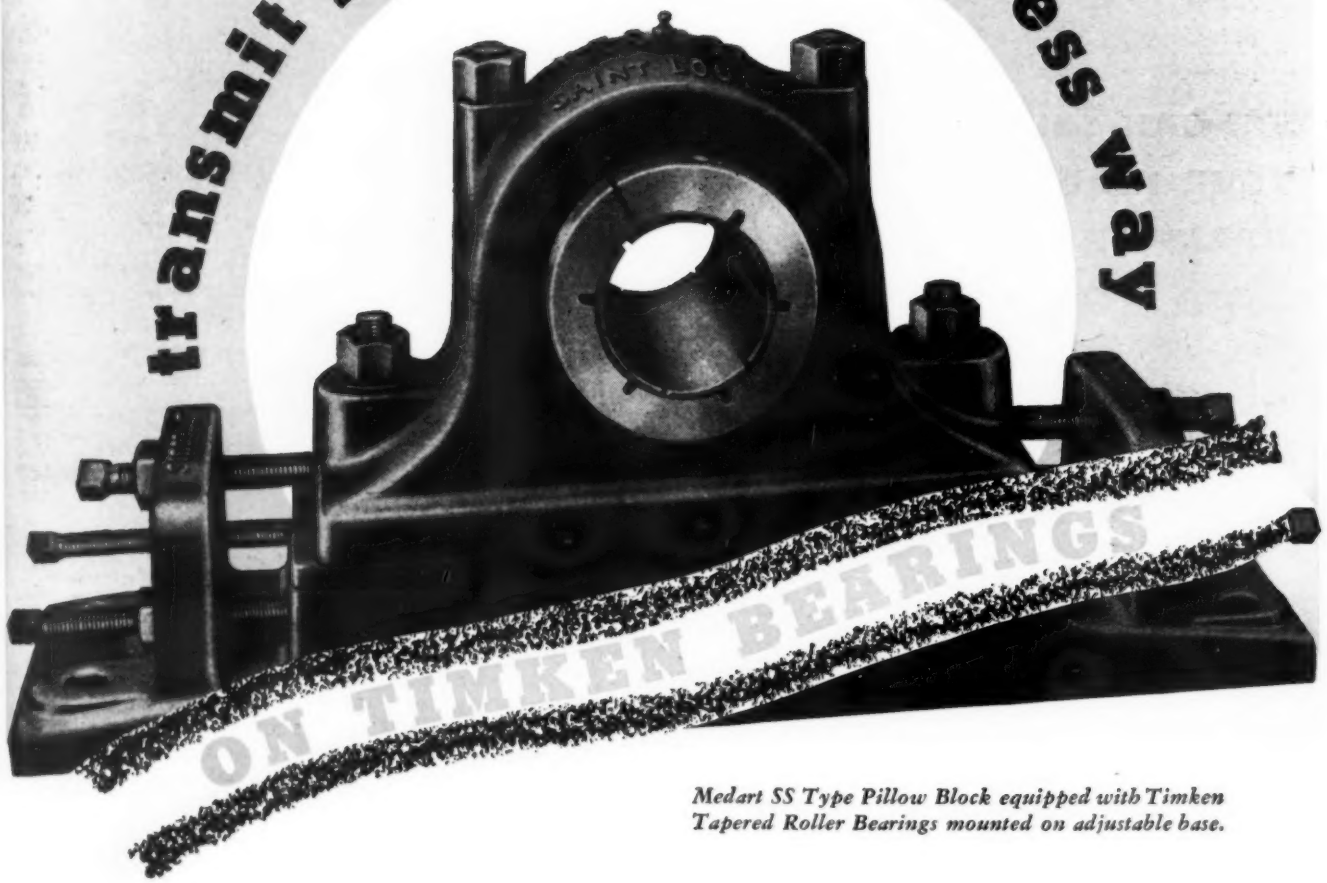
Specify Hewitt for quality industrial rubber products. Phone the Hewitt distributor listed in the Classified Section of your telephone directory . . . or write to the Hewitt Rubber Corporation, 240 Kensington Avenue, Buffalo 5, N. Y.

Quality Rubber Products for Industry for 86 Years

HEWITT RUBBER
of Buffalo
Job-Engineered Industrial Hose • Belts • Molded Goods

transmit power the wasteless way



Medart SS Type Pillow Block equipped with Timken Tapered Roller Bearings mounted on adjustable base.

A tremendous volume of power has been — and is being — wasted through obsolete mechanical transmission equipment; burned up by friction before it reaches the point of application.

Every unit of power lost means an increase in power cost. In addition an excessive amount of lubricant is required together with many extra man-hours to apply it. There is, furthermore, an ever-present danger of product damage or contamination through lubricant leakage. Maintenance is high because, among other things, rapid shaft wear is prevalent.

Add to all this the constant threat of unscheduled work stoppages through power interruptions resulting from transmission failures and you have a strong case in favor of replacing your obsolete, worn-out, plain bearing transmission equipment with modern Timken Bearing Equipped units *now*. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

SCOPE*

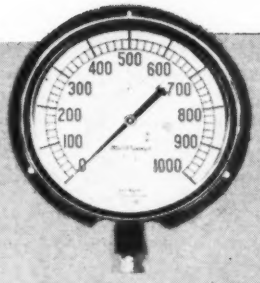
There is a pressure gauge for every purpose in the broad Marsh Line

No less important than the time honored precision and accuracy of Marsh Pressure Gauges is the scope of the Marsh line. There is a Marsh Gauge for every pressure medium; every pressure range; every service condition—a style and size of case for every application and mounting.

Space permits showing only a part of the regular line of Marsh Gauges—and beyond these stock types are the hundreds of "specials" that have been developed for manufacturers who use gauges in quantities.

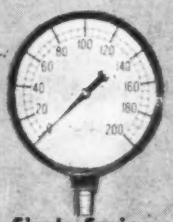
Whatever your requirements there is a Marsh Gauge that will fill them . . . *better.*

JAS. P. MARSH CORPORATION
2075 Southport Ave., Chicago 14, Illinois

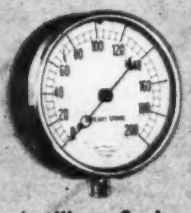


The *Mastergauge* line

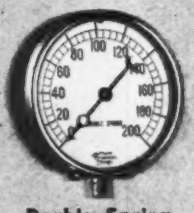
—Marsh accuracy and stamina at its highest. Mastergauges are made in pressure ranges up to 10,000 lbs.; also in compound (vacuum and pressure) types and as altitude gauges. A full range of case patterns is available.



Single Spring Gauge



Auxiliary Spring Gauge



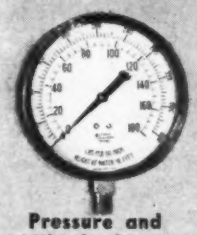
Double Spring Gauge

Standard Gauges

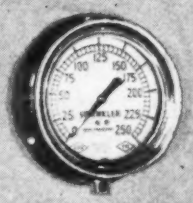
The standard line of Marsh gauges is made in single spring type for ordinary service; auxiliary and double-spring types for fluctuating pressures or where extreme vibration is present. Many ranges, 0-15 to 0-2000 lbs. Full range of cases.

Standard Vacuum Gauge.

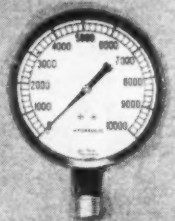
Standard Compound Gauge.



Pressure and Altitude Gauge



Sprinkler Gauge

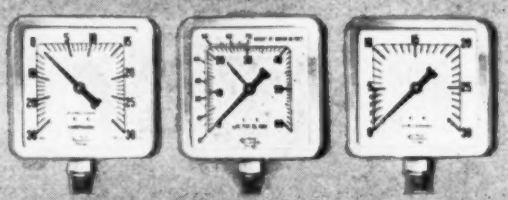


Hydraulic Gauge

Ammonia Gauge

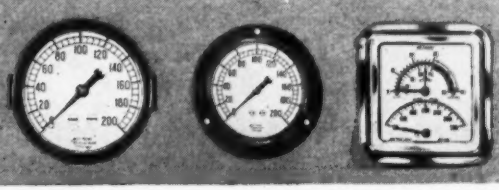
Maximum Reading Gauge

Diaphragm Gauge



House heating gauges (A.S.M.E. standard) in all types: Low pressure steam gauges; compound gauges; combination pressure and altitude gauges; retard gauges; pressure, altitude and thermometer combinations, etc.

CASES OF ALL KINDS. Just a few are illustrated below—



MARSH GAUGES

DIAL THERMOMETERS
HEATING SPECIALTIES

*One of a series of advertisements high-lighting the factors that make Marsh instruments "THE STANDARD OF ACCURACY"

The Answer TO YOUR INSTRUMENT PROBLEMS

Burlington

PANEL INSTRUMENTS

Burlington Panel Instruments are designed and built to give dependable service with guaranteed accuracy. They are available in a complete line of AC or DC Ammeters, Voltmeters, Milliammeters, and Microammeters. The wide selection of sizes and case styles offer instruments that are ideal for your particular application.

Write today for full details—our engineers will recommend the precision Burlington Instruments required to solve your instrument problems.

BURLINGTON INSTRUMENT CO.
702 Fourth St., BURLINGTON, IOWA

B PANEL INSTRUMENTS • VOLTAGE REGULATORS • AUTOMATIC SYNCHRONIZERS • FREQUENCY REGULATORS

Are you equipped to hold your job?—to get a new one?

The men who are keeping their jobs today—who are not feeling the whip of competition—are those who have kept one jump ahead of their jobs. They are the men who are equipped with a thorough-going and growing knowledge of the business they are in.

It works in the power plant field as well as in any other. Some men fit themselves to do a little more than their job calls for. They fit themselves to do a little more than the other fellow. They make a steady effort to equip themselves with the best kind of job insurance there is—KNOWLEDGE.

How about you? Do you know how quickly knowledge will pile up—how quickly you will become more valuable—if you spend a few minutes a day, regularly studying sound books like the McGraw-Hill Library of Power Plant Practice? Do you know how easily it can be managed, paying only a few cents a day, while you use the books?

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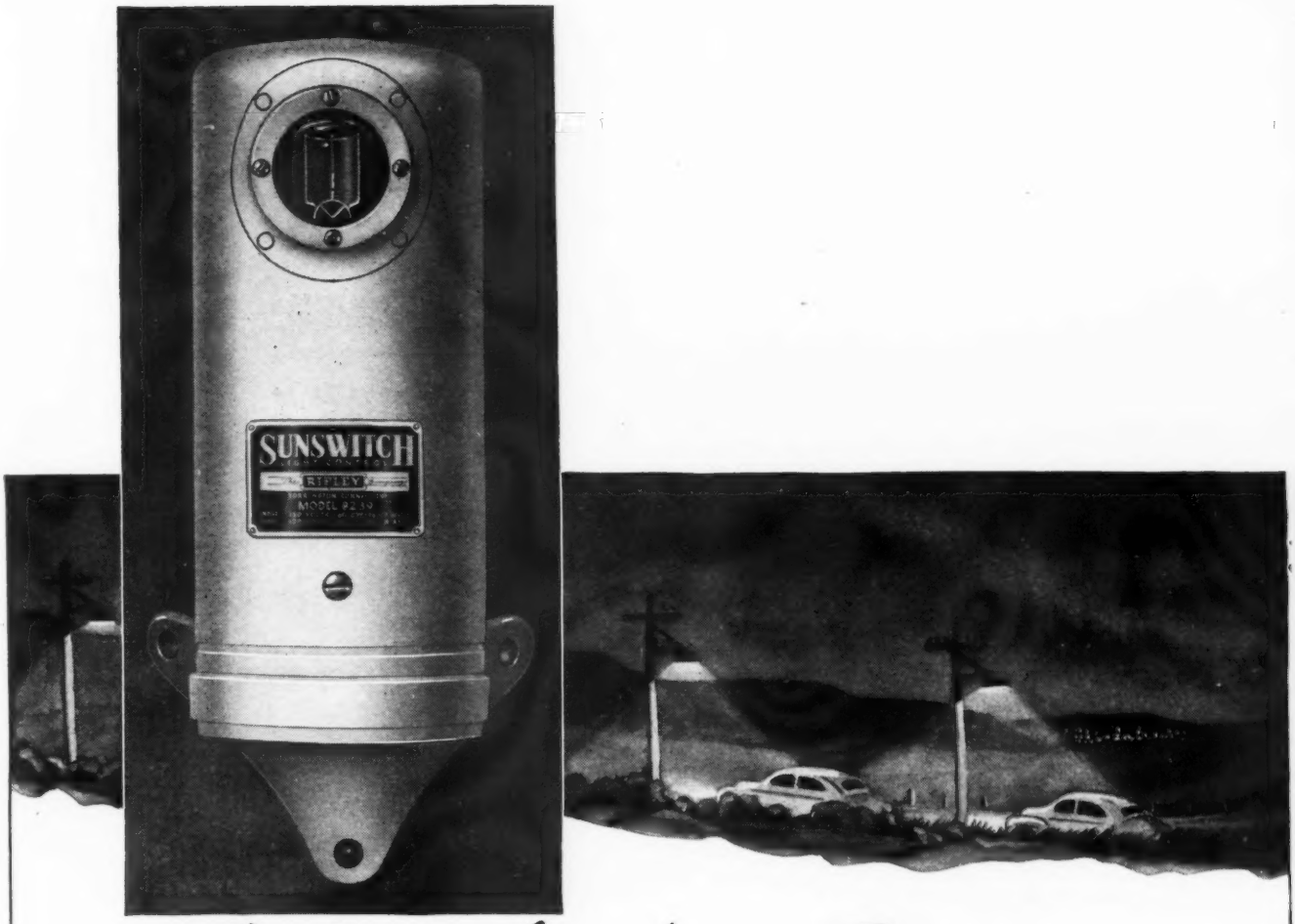

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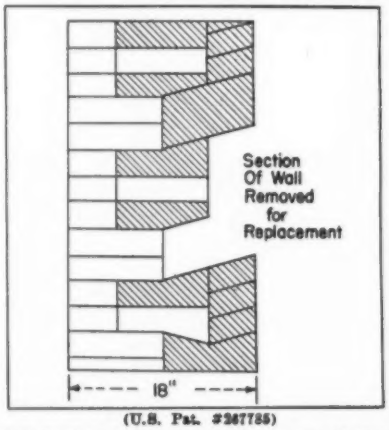

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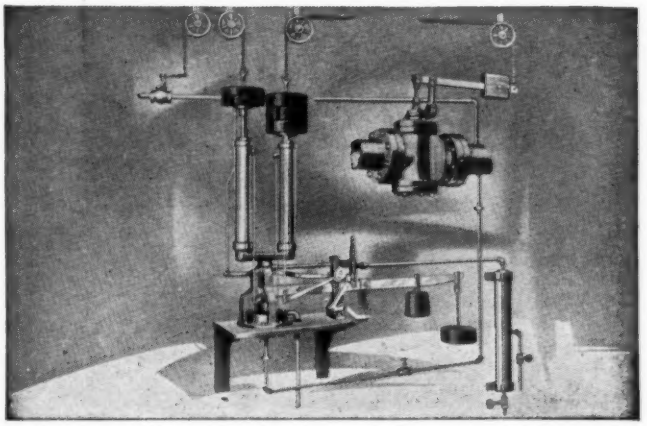

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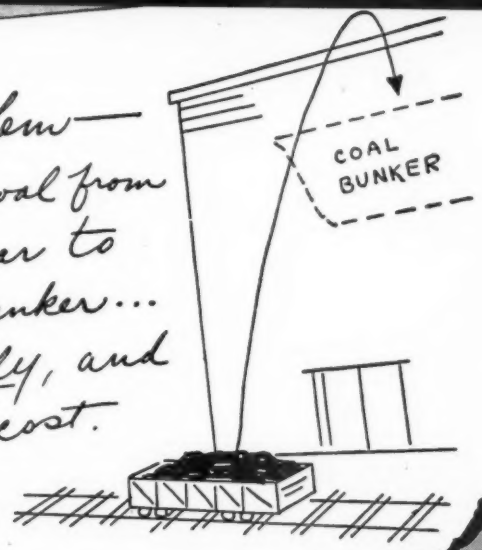

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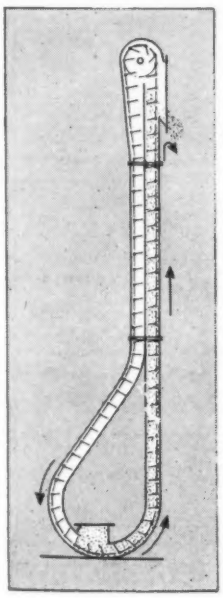

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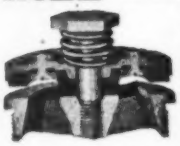

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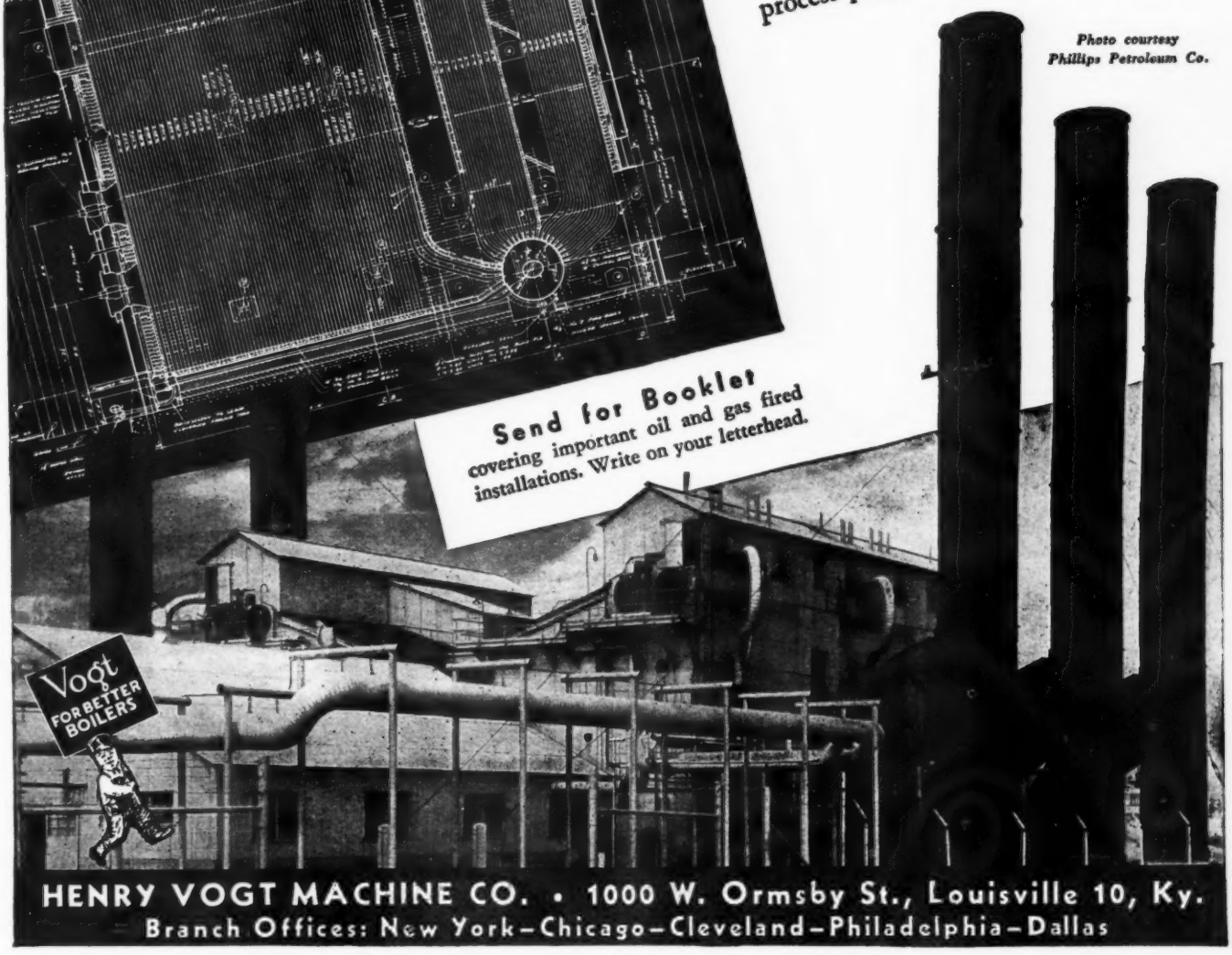

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G.E. & WEST. NEMA FRAME MOTORS

7—¾ H.P. 1200 RPM Open
14—1½ H.P. 1800 RPM Open
2—3 H.P. 1200 RPM XP
7—5 H.P. 3600 RPM Open
4—5 H.P. 3600 RPM TEFC
7—7½ H.P. 1800 RPM Open
7—10 H.P. 3600 RPM Open
7—10 H.P. 1800 RPM Open
14—15 H.P. 1800 RPM Open
7—15 H.P. 1800 RPM TEFC

2 Ph. Squirrel Cage Motors

Qu.	H. P.	Make		Speed
1	100	West.	CS-663C	1750
1	100	G. E.	KQ-547	1155
1	70	G. E.	Synch.	1200
1	75	G. E.	IQE	1750
1	50	Lincoln	C-15	870
1	50	G. E.	IQ	870
1	40	Al. Ch.		870
1	35	Al. Ch.		870
1	30	West.	CCL	1150
1	30	Wagner	BP	1140
1	25	Burke		870
3	25	G. E.	IQL	1150
1	25	West.	CCL	1150
1	15	F-M		1750
1	15	Wagner		1750
1	15	G. E.	KQ-502	1150
1	15	West.	CS	1155
1	15	Al. Ch.		1130
1	15	West.	CS-572	860
1	15	G. E.	IQ	690

A.C. Slip Ring Motors

Qu.	H. P.	Make	Type	Speed
1	250	G. E.	IM	600
1	150	El. Dy.	L-263	1770
1	125	Al. Ch.		695
1	112	G. E.	ITC	720
1	100	G. E.	IM	720
1	100	F-M	BA	720
1	79	G. E.	IM	1150
1	79	West.	CW	1170
3	75	G.E.	MT-352	870
1	75	Al. Ch.	Hoist	575
1	64	G. E.	MTO-552	585
1	60	West.	CW-956A	290

A.C. Slip Ring Motors

Qu.	H. P.	Make	Type	Speed
1	52	G. E.	ITC	860
1	50	Al. Ch.		865
1	50	G. E.	MT-342	860
1	40	F-M	BB	1150
1	40	West.	CW	1150
1	40	West.	HF	850
1	40	Lincoln	IXL	690
1	40	G. E.	MT-352	870
1	35	Al. Ch.		870
1	35	Burke	DMB-7	720
1	30	G. E.	ITC	1200
1	30	G. E.	M-526	1150
1	30	G. E.	MQ-332	870
1	30	West.	CI-574A	870
4	30	West.	CI-582C	870
2	30	G. E.	MT-542	690
2	25	Al. Ch.		870
1	25	Howell	SRS-420	870
1	20	West.	CW	870
1	20	G. E.	MT-332	600
1	15	G. E.	MT-502	1130
1	15	West.	CW	870
1	15	G. E.	MT-512	845
1	15	Al. Ch.		680
2	15	G. E.	ITC-5010	695
1	15	G. E.	MQ-332	670

A.C. Generators

Qu.	K.W.	Make	Voltage	Speed
1	150	G. E.	240/480	600
1	100	West.	240/480	600
1	50	G. E.	208/120	1200
1	50	F-M	240/480	1200
1	50	El. My.	208/120	900
1	30	Burke	220/440	900

230 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	350	West.	SK	340/425
1	75	Burke	AM-15S	575
1	60	G. E.	C-Inter.	480/1100
1	50	West.	SK-150	550/1100
1	50	G. E.	RC-19	400/1200
1	45	Diehl	K-10	850
1	40	G. E.	DLC	1050
2	35	West.	SK-120	1150
1	35	G. E.	RLC-204	440/800
2	35	West.	SK-160	400/600
1	30	G. E.	RC-32	1100
1	30	West.	SA	500/1500
3	25	G. E.	RC-31	1150
1	25	West.	SK	1100
1	25	Reliance	92T	1150
1	25	L-A	FNA-1043	900
1	25	A-L		850
1	25	Rel.	MS	500/1500
1	25	Rel.	H3	400/1200
1	25	G. E.	RF	400/1200
3	20	G. E.	RF	500/1500
1	20	G. E.	RF	400/1200
1	20	G. E.	CD-83	1200
1	20	R. & M.		1160
1	20	G. E.	RC-11	1150
1	20	Ele. Dyn.	7½-S	950
3	20	West.	SK-110L	750
1	20	West.	Hoist	700
1	20	West.	SK-120	300/1200
1	15	Rochester		3450
1	15	West.	SK-83	1150
2	15	G. E.	RC	1150
1	15	G. E.	CD-Vert.	900
1	15	G. E.	CD-85	850
2	15	G. E.	RC-30	850
1	15	Sprague	D	700
1	15	West.	SK	675/1350
1	15	West.	SK-100L	600/2500
1	9	L-A	Baler	1750
4	10	G. E.	RC	1150
2	10	G. E.	CD-75	1150
1	10	Diehl		900
1	10	G. E.	RC	29/850
1	10	G. E.	CD-83	850
1	10	Roth		800
1	10	Diehl	LS-14	750
1	10	West.	Elevator	700
1	10	G. E.	CVC	700
1	10	West.	SK	600/1200
1	10	G. E.	RLC	500/1500
1	10	West.	SK	500/1500

230 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	10	El. Dyn.		450/1800
2	10	G. E.	RF-10	400/1600
2	10	West.	SA	400/1200
1	10	West.	SK-90	400/1200
1	10	Diehl		200/ 247
1	7½	Sturt.	TF	3600
1	7½	El. Dyn.	2S	1750
1	7½	G. E.	RC	1150
6	7½	West.	SK-40	1180
1	7½	G. E.	CO-1804	
1	8	L-A	Baler	1200
2	7½	West.	SK	850
2	7½	G. E.	RC	850
1	7½	West.	SK-60	850
2	7½	G. E.	RF-9	600/1800
1	7½	G. E.	RF-10A	600/1500
1	7½	West.	SK-90	650/1300
1	7½	El. Dyn.	3S	550/1650
1	7½	G. E.	RF-10	450/1800
1	7½	G. E.	RF-10	450/1600
1	7½	G. E.	RF	450/1800
2	7½	West.	SK-70	400/1600
1	7½	Al. Ch.		350/1050
1	7½	L-A	Baler	

110 Volt D.C. Motors

Qu.	H.P.	Make	Type	Speed
1	45	G. E.	RC	1100
2	10	Lincoln	I-SC	3500
1	10	L-A		3500
1	10	E. Dyn.	3S	1100
1	10	West.	SK-70	1150
1	10	Reliance		400/1600
2	10	Diehl		230
1	7½	G. E.	CVC	725
1	7½	El. Dyn.	5S	450/900
1	7	El. Dyn.		600/1200

D.C. Generators

KW	Make	Voltage	Ampere	Speed
300	Burke (2)	250/125	1200	900
300	West. (2)	250	1200	900
250	G. E.	125	2000	720
150	Cr. Wh.	125	1200	900
150	Ridgeway	250	600	900
100	Cr. Wh.	250	400	570
100	G. E.	125	800	1150
50	G. E. (2)	125	400	1150
50	G. E.	250	200	870
30	El. Dyn.	600	50	1150
30	G. E.	125	240	1150
25	G. E.	125	200	1150
20	West.	250	100	1150
10	West.	250	40	1150
10	West.	125	80	1150
7½	G. E.	250	30	1150
7½	West.	125	60	1150

AIR COMPRESSORS

12½" x 12"	**American**
10" x 6"	**Gardner**
9" x 8"	**Ingersoll Rand**
9" x 8"	**Sullivan**
7" x 6"	**Ingersoll Rand**

LARGE FANS

11—Buffalo and Sturtevant Latest Type—Like New—50,000 Cu. Ft., 17" Pressure at 1760 RPM.

D.C. to A.C. Generators
1 to 10 K.V.A.
115 and 230 V.D.C. to 1 ph. and 3 ph. 110-220 & 440 V. A.C.

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L. J. LAND & COMPANY

146 GRAND STREET, NEW YORK 13, NEW YORK

Established 1910 **CAnal 6-6976**

WHEN YOU BUY USED EQUIPMENT LOOK FOR

When used equipment is rebuilt in the Hemphill Shops it is rebuilt to the same HIGH STANDARDS of workmanship and performance as those of the original manufacturer. All Hemphill rebuilding and testing is done under the supervision of Electrical Engineers. This is a *plus-value* you get in Hemphill Equipment.

HEMPHILL VALUES ARE PREJUDGED

MOTOR GENERATOR SETS

1—150 KW. 125 Volt Westinghouse, Squirrel Cage
2—100 KW. 230 Volt General Electric, 440 volt, 3 phase, 1200 RPM. Sq. Cage
1—75 KW. 125 Volt General Electric, Squirrel Cage

TURBO GENERATORS

1—600 KW. Terry dual bleeder condensing Turbine only
1—300 KW. 125/250 Volt General Electric non-condensing
1—300 KW. General Electric, 3 phase, 60 cycle, 220 volt cond.
1—200 KW. General Electric, 3 phase, 60 cycle, 220 volt cond.
1—30 KW. 135 volt, Allis-Chalmers, non-cond.

ALTERNATORS

1—500 KW. 3600 RPM. 600 volt, General Electric D.C. exciter
1—200 KVA 3600 RPM. 240 volt, Allis-Chalmers D.C. exciter
I—180 KW. 514 RPM. 550 volt, Westinghouse
1—165 KW. 514 RPM. 2400 volt. Electric Mach.
1—150 KW. 900 RPM. 2300 volt, General Electric, type ATB
1—62½ KW. 3600 RPM. 220 volt, Allis-Chalmers
1—40 KW. 1800 RPM. 550 volt, General Electric
1—35 KW. 1200 RPM. 240 volt, Columbia Electric D.C. exciter
1—31.3 KVA. 1200 RPM. 120/208 volt, American D.C. exciter
1—12.5 KVA. 1200 RPM. 240 volt, Westinghouse, D.C. exciter

MOTORS—VARIABLE SPEED
230 VOLTS

2—200 H.P. 425/212 RPM. General Electric MPC
2—100 H.P. 950/1170 RPM. General Electric RC-37
1—60 H.P. 500/1000 RPM. Diehl
1—40 H.P. 700/1000 RPM. Sprague L.C.
1—30 H.P. 400/1200 RPM. General Electric R' C-204
1—30 H.P. 225/900 RPM. Crocker Wheeler CMC
1—25 H.P. 650/2200 RPM. Westinghouse SK-110L.
1—25 H.P. 500/1500 RPM. General Electric RF-12
1—25 H.P. 400/1200 RPM. Westinghouse SK
2—25 H.P. 300/900 RPM. Electro Dynamic
1—15 H.P. 300/1200 RPM. General Electric RLC-2024
1—13/18 H.P. 350/1200 RPM. Electro Dynamic
3—11½ H.P. 500/1500 RPM. Westinghouse
1—7½/10 H.P. 500/1500 RPM. Reliance
1—6/7.5 H.P. 450/1800 RPM. Crocker Wheeler CMC
1—5 H.P. 500/1500 RPM. Reliance
1—5 H.P. 600/1200 RPM. General Electric LC
1—5 H.P. 450/1800 RPM. Crocker Wheeler CM
1—5 H.P. 400/1600 RPM. Diehl K6
1—5 H.P. 225/900 RPM. Electro Dynamic

TRANSFORMERS

2—400 KVA. General Electric, 4156-250/480 volt, Scott taps
3—300 KVA. Pittsburgh 7800/440 volt
3—150 KVA. General Electric 33000/2300/4000Y
3—150 KVA. General Electric 2200/220/440 volt
1—100 KVA. General Electric 2200/220/440 volt
3—100 KVA. Westinghouse 11430/250 volt
3—100 KVA. General Electric 13200/250 volt
3— 75 KVA. General Electric 13500/750/440 volt
1— 75 KVA. General Electric, 3 phase, 4156Y-120/208Y
2— 50 KVA. Pittsburgh 7500/15000 V. 110/220 v.
2— 15 KVA. General Electric 2300-115/230 volt
3— 75 KVA. General Electric, 2300-220/440 volt

GASOLINE DRIVEN
D. C. GENERATOR SETS

2—25 KW. 125 volt
1—30 KW. 125 volt
1—120 KW. A.C. 240 volt, 3 phase

MOTORS 3 PHASE 60 CYCLE
SQUIRREL CAGE

1—400 H.P. 1200 RPM. Westinghouse 220 volt
1—150 H.P. 1750 RPM. General Electric IK 440 volt
1—150 H.P. 870 RPM. General Electric HI-15 220 volt
1—150 H.P. 720 RPM. General Electric IK 440 volt
1—150 H.P. 400 RPM. General Electric I-17 440 volt
1—125 H.P. 1750 RPM. Cont. Electric 2200 volt
2—100 H.P. 1800 RPM. General Electric IK 440 volt
1—100 H.P. 425 RPM. General Electric HI-16 440 volt
1— 90 H.P. 380 RPM. Crocker-Wheeler 550 volt
1— 75 H.P. 870 RPM. Allis-Chalmers ARZ 220 volt
1— 75 H.P. 690 RPM. Westinghouse 550 volt
1— 60 H.P. 900 RPM. Howell Mfg. Co. SC. 220 volt
2— 50 H.P. 900 RPM. Fairbanks-Morse H. 220 volt
1— 50 H.P. 695 RPM. General Electric IK 220 volt
1— 50 H.P. 680 RPM. Westinghouse 220 volt
2— 50 H.P. 565 RPM. Westinghouse 440 volt
1— 50 H.P. 575 RPM. General Electric IK 220 volt
1— 50 H.P. 514 RPM. General Electric IQK 220 volt

MOTORS 3 PHASE 60 CYCLE
SLIP RING

1—500 H.P. 900 RPM. Lincoln 440 volt
1—350 H.P. 293 RPM. General Electric MT-424 440 volt
1—250 H.P. 600 RPM. General Electric IM 2200 volt
1—225 H.P. 1800 RPM, General Electric I-E 220 volt
1—200 H.P. 600 RPM. Crocker Wheeler S.R. 440 volt
1—200 H.P. 600 RPM. Westinghouse CW 220 volt
1—150 H.P. 1750 RPM. Westinghouse CW 220 volt
1—100 H.P. 720 RPM. General Electric IM 220 volt
1—100 H.P. 720 RPM. Westinghouse CW 440 volt
1—100 H.P. 695 RPM. General Electric IM 440 volt
1— 75 H.P. 900 RPM. Allis-Chalmers 2K 220 volt
1— 75 H.P. 900 RPM. General Electric ITC 220 volt
1— 75 H.P. 690 RPM. Allis-Chalmers 220 volt
1— 75 H.P. 570 RPM. General Electric IM 220 volt
1— 60 H.P. 575 RPM. Allis-Chalmers 220 volt
1— 50 H.P. 900 RPM. General Electric IM 220 volt
1— 40 H.P. 1150 RPM. Cont. Electric SA85 220 volt
1— 40 H.P. 1130 RPM. General Electric MT 2200 volt

MOTORS D. C. 230 VOLTS

2—450 H.P. General Electric MPL 250 volt
1—250 H.P. 750 RPM. Electro Dynamic 230 volt
1—100 H.P. 625 RPM. General Electric-Sprague LC 230 volt
1— 80 H.P. 600 RPM. Crocker-Wheeler CMC 230 volt
1— 75 H.P. 575 RPM. General Electric C 230 volt
1— 66 H.P. 535 RPM. Crocker Wheeler SCM 230 volt
4— 50 H.P. 700 RPM. Crocker Wheeler CM 230 volt
2— 30 H.P. 1150 RPM. General Electric RC-31 230 volt
1— 30 H.P. 1100 RPM. General Electric RC-12 230 volt
1— 30 H.P. 750 RPM. General Electric RC-14 230 volt
1— 30 H.P. 725 RPM. Westinghouse SK 230 volt
1— 30 H.P. 625 RPM. General Electric C 230 volt
1— 25 H.P. 1150 RPM. General Electric CD-93 230 volt
1— 25 H.P. 775 RPM. General Electric RC-13 230 volt
1— 25 H.P. 775 RPM. General Electric RC 230 volt
1— 25 H.P. 600 RPM. Westinghouse SK 230 volt
1— 20 H.P. 800 RPM. General Electric RC-12 230 volt
1— 15 H.P. 1750 RPM. General Electric CD-67 230 volt
1— 15 H.P. 350 RPM. Diehl G-312 230 volt

JLH

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J. L. HEMPHILL & CO.

1601 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-3227

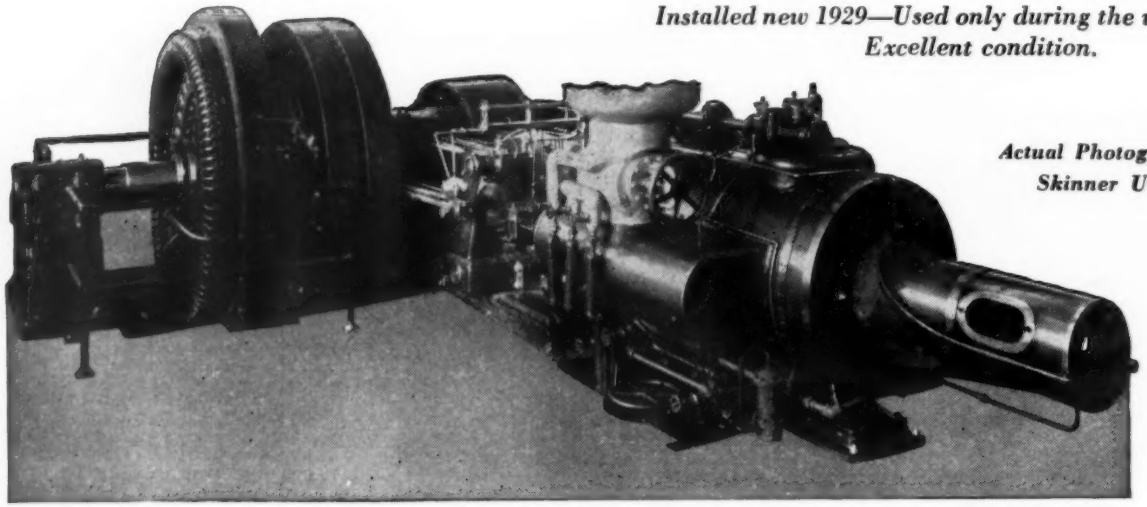
PHONE NEW JERSEY—UNION 3-2600

365 and 260 KVA Skinner Uniflow Engine Generator Sets

365 KVA and 260 KVA General Electric alternating current generators 3 phase 60 cycle 240/480 volts direct connected to Skinner Universal uniflow left hand side crank engines, 150-175 lbs. steam pressure, 0-5 lbs. back pressure.

Generators equipped with switchboards. Engines equipped with full floating pistons, lay shaft valve gears, bored guides, automatic lubrication and interconnecting piping.

Installed new 1929—Used only during the winter months
Excellent condition.



Actual Photograph 365 KVA Skinner Uniflow Unit

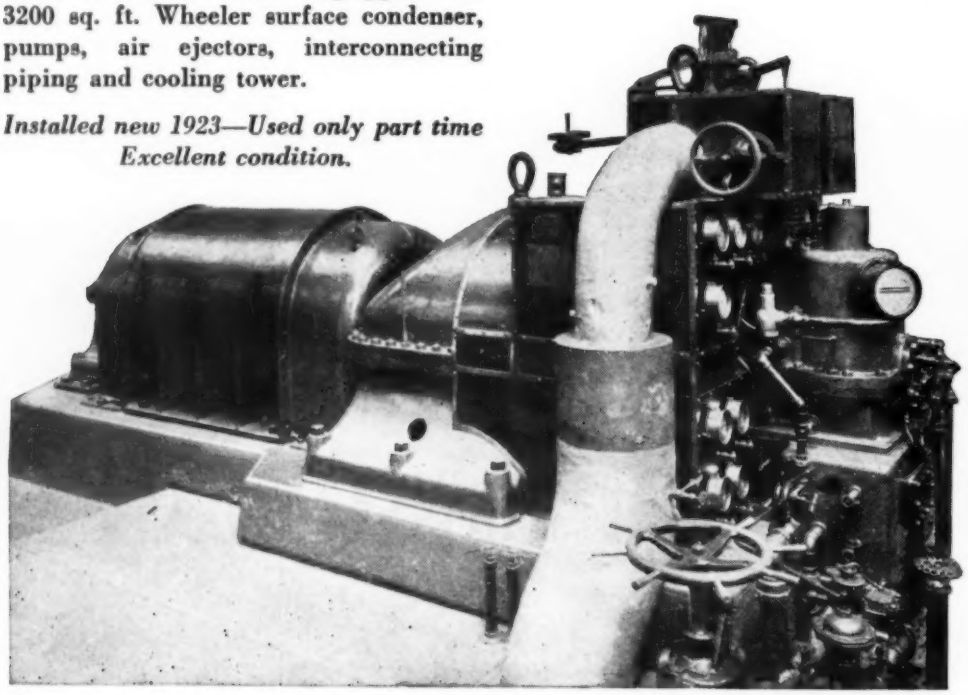
1875 KVA Westinghouse Automatic Extraction Turbine Generator Unit

1875 KVA Westinghouse alternating current generator 3 phase 60 cycle, 480 volts, 3600 RPM, direct connected to Westinghouse automatic extraction type condensing turbine, 175-250 lbs. steam pressure, 600 degrees maximum T.T., 0-25 lbs. extraction pressure, 3600 RPM.

Generator equipped with air filter, exciter and switchboard. Turbine equipped with 3200 sq. ft. Wheeler surface condenser, pumps, air ejectors, interconnecting piping and cooling tower.

Installed new 1923—Used only part time
Excellent condition.

Actual Photograph



INTERNATIONAL POWER MACHINERY COMPANY

UNION COMMERCE BLDG.
TELEPHONE: MAIN 9514
CLEVELAND 14, OHIO

Let's get down to Belyea Brass Tacks.

WHAT BELYEA RE-NU-BILT SIGNIFIES

Because WE Own It . . .
. . . YOU Get It Quicker

You get RE-NU-BILT Equipment with minimum delay because we *own* what we advertise. We do not have to use up time for negotiation after your order is placed. Our workmen have been specially trained to rebuild electrical power equipment and therefore do the rebuilding in a minimum time.

Here Is A List of Today's RE-NU-BILT EQUIPMENT . . .

. . . With A Guarantee of SUCCESSFUL OPERATION

MOTOR GENERATOR SETS

3 phase—60 cycle

1—800 KVA. GE 300 KW—220/440 V. A.C. Gen. to 500 HP 230 V. D.C. Motor.
1—400 KW Al. Ch. 250 V. D.C. Gen. to 650 HP 220/440 V. Syn. Motor with exciter.
1—200 KW—GE 575 V. D.C. to 300 HP—2200 V. Ind.
2—150 KW—Whse. 600 V. D.C. to 200 HP—2200 V.
1—150 KW Whse. 250 V. D.C. to 200 HP—2200 V. Ind.
1—150 KW Whse. 3 unit (2) 75 KW 125 V. Gen. D.C. to 200 HP—2300 V. Ind.
1—75 KW GE 125 V. D.C. to 120 HP—2300/4000 V. Ind.
1—50 KW GE 125 V. D.C. to 75 HP—2300/4000 V. Ind.

TRANSFORMERS—60 Cycle

Qu.	Kva.	Make	Ph.	Type	Voltages
3	1667	Pitts.	1	OISC	13200x2300
1	1050	G.E.	3	WCTH	11000x445/222½
4	525	G.E.	1	HJ	2300x445
4	500	Pitts.	1	OISC	13200x2300
2	333	Pitts.	1	OISC	2400x220
2	333	Whse.	1	OISC	2300x460
1	300	Pitts.	3	OISC	4150x208/120
3	200	G.E.	1	HLLD	27600x115/460
2	200	G.E.	1	HKDD	13800x220/440
1	200	Whse.	1	JK	6600x220/440
3	200	G.E.	1	HJ	2300x408/204
1	200	G.E.	2-3	Auto	2500x2500
1	200	G.E.	1	H	2300x115/230
1	125	Maloney	1	C	2300x230/460
3	100	G.E.	1	HJDD	13200x445/226
3	100	Whse.	1	OISC	13200x250

A. C. MOTORS

3 Phase—60 Cycle
SLIP RING

Qu.	H.P.	Make	Volts	R.P.M.	Desc.
1	2500	G.E.	6600	253	MT
1	1200	Cr. Wh.	2300	237	801Q
1	800	Al. Ch.	440	885	ANY
1	600	Cr. Wh.	2200	507	131 AQ
1	600	G.E.	2300	600	MT-422-3 Brg.

Qu.	H.P.	Make	Volts	R.P.M.	Desc.
1	600	Whse.	440	400	CW
1	500	Al. Ch.	2200	590	ANY-36
1	400	Al. Ch.	2300	505	ANY
1	400	G.E.	2200	252	1P
1	400	Cr. Wh.	440	590	29Q
1	350	G.E.	4000/2300	253	MT-442Y
1	300	G.E.	440	585	IM-17B
1	300	Cr. Wh.	440	440	29Q
1	250	G.E.	4000	257	MT-424Y
1	200	G.E.	440	450	IM-3 Brg.
1	200	G.E.	2200/550	1750	IE-13B
1	200	G.E.	2200	600	IM
1	150	Whse.	440	495	CW-956
1	150	Whse.	440	435	CI-954A

SQUIRREL CAGE

1	400	G.E.	2200	1175	IE-15B
1	300	G.E.	440	900	IK
1	200	Whse.	2200	1800	CS
1	200	G.E.	550	580	IK
1	200	G.E.	2200	490	IK
2	200	G.E.	2300	1175	IK
1	200	G.E.	440	580	IK
1	200	Al. Ch.	2300	1175	
2	175/112	G.E.	440	900/720	IK
1	150	Whse.	550	400	CS-594A
3	150	G.E.	440	1200	K-63258 B. Brg.

SYNCHRONOUS

2	2100	G.E.	2200/4400	514	ATI
1	600	Al. Ch.	2200	720	
1	300	G.E.	2200	1200	ATI
1	125	G.E.	2300	900	ATI.
1	75	G.E.	220	600	TS-7556

SYNCHRONOUS CONDENSER

Qu.	Kva.	Make	Volts	R.P.M.	Desc.
1	750	G.E.	220/440	900	ATI
1	3000	Al. Ch.	2300	900	
1	5000	Whse.	2300/4000	900	

ROTARY CONVERTERS

3 PHASE—60 CYCLE

Qu.	Kw.	Make	Speed	D.C.V.	Trans. V.
1	1500	Whse.	720	600	2300
1	1500	Whse.	600	600	11500
1	1250	G.E.	720	250	2300
1	1000	G.E.	900	600	13200
1	1000	Whse.	900	600	11000
2	750	G.E.	1200	600	2300
1	750	Whse.	720	250	6600/2300
1	500	Whse.	1200	600	13200/2300
2	375	G.E.	1200	250	6600/2300
1	300	G.E.	1200	600	2300

3 PHASE—25 CYCLE—BOOSTER TYPE

2	1500	G.E.	500	225/275	13200/6600

All units can be furnished with A. C. & D. C. control

SPECIAL

1—2000 amp., 3 pole, 15000 V. Condit type F-120-15 D, 230 V Sol. operated OCB—1000 000 uninterrupting Capacity.

D. C. MOTORS

Qu.	H.P.	Make	Type	Volts	Speed
2	1250	G.E.	MPC	500	130
1	800	G.E.	MPC	550	600
1	650	G.E.	MPC	250	115/145
2	625	G.E.	MPC	500	130
1	500	G.E.	MPC	230	900
3	350	G.E.	MPC	230	450
1	300	G.E.	MPC	230	275/550
1	250	G.E.	MPC	230	400/500
1	250	Al. Ch.		230	525
1	250	Whse.	SK	230	275/690
1	200	Whse.	SK-191	230	850
2	135/175	G.E.	MCF	230	450/1050
1	150	G.E.	MPC	230	250/450
2	130	Cr. Wh.	CMC-65H	550	1200
2	125	G.E.	CO-1832	230	625

TURBO GENERATOR SETS

1—500 KW—Whse. 625 KVA, 440 v. 3 ph. 60 cy. 3600 RPM with Parsons 145/175 lbs. condensing turbine with jet condenser and accessories.
1—75 KW Ridgeway 250 V. D.C. with Terry 180 lb. with 12 lb. back pressure, 2000 RPM.

Have You Surplus Electrical Equipment? **WE BUY FOR STOCK — FOR CASH.**

Belyea

38TH YEAR OF SERVICE

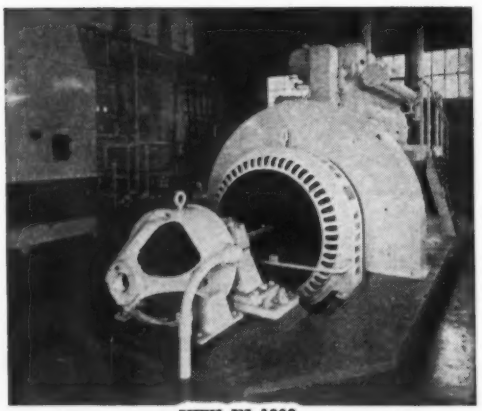
COMPANY, INC.

Main Office & Shop

43 HOWELL ST., JERSEY CITY, N. J.

"SUCCESSFUL OPERATION GUARANTEED"

DIESELS

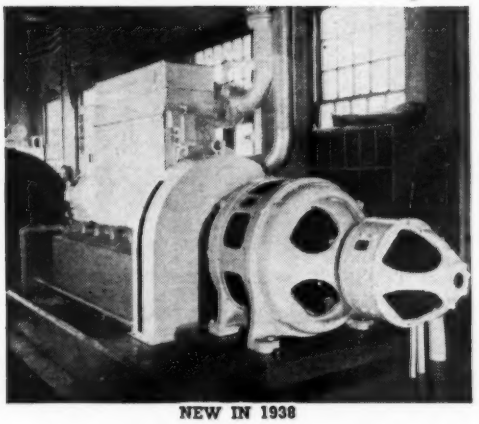


NEW IN 1938

375 HP MC INTOSH SEYMOUR. Model 5B25—5 Cylinder—12½"x 18"—4 cycle, solid injection—360 RPM

direct connected to

312.5 KVA Westinghouse generator—3/60/240—with exciter, switchboard and synchronizer.



NEW IN 1938

150 HP NATIONAL SUPERIOR. Type VDMB. 4 cylinder — 9"x12" — 4 cycle—Solid injection, 514 RPM.

direct connected to

125 KVA Westinghouse generator — 3/60/240—with exciter, switchboard and synchronizer.

This fine plant which may be inspected in operation is unusually complete, including Buffalo evaporative coolers for closed system jacket water cooling with all necessary auxiliaries.

MODERN FAIRBANKS MORSE GENERATING STATION

MODEL 32 E 14—300 R. P. M.

1—420 H.P., 350 KVA., 3/60/2400
1—375 H.P., 312 KVA., 3/60/2400
1—360 H.P., 294 KVA., 3/60/2400
1—225 H.P., 185 KVA., 3/60/2400

COMPLETE—NOW OPERATING—SWEET WATER COOLING SYSTEM—VOLTAGE CHANGED TO SUIT

REBUILT and GUARANTEED

SEVERAL OTHER IMPORTANT OFFERINGS

Voltage will be corrected to your requirements

750 HP Enterprise	6 cyl	600 KVA	3/60/2400	1938
750 HP Superior	8 cyl	600 KVA	3/60/2400	1933
375 HP Alco	5 cyl	372 KVA	3/60/240	1938
375 HP Fairbanks	5 cyl	300 KVA	3/60/2400	1936
360 HP Fairbanks	6 cyl	300 KVA	3/60/2400	1932
330 HP G. M. Winton	4 cyl	282 KVA	3/60/240	1937
262 HP Buckeye	7 cyl	219 KVA	3/60/2300	1938
225 HP Buckeye	6 cyl	187 KVA	3/60/480	1941
187 HP Buckeye	5 cyl	150 KVA	3/60/240	1937
240 HP Buckeye	3 cyl	187 KVA	3/60/2300	1932
150 HP Buckeye	4 cyl	125 KVA	3/60/480	1939
112 HP Buckeye	3 cyl	94 KVA	3/60/240	1939

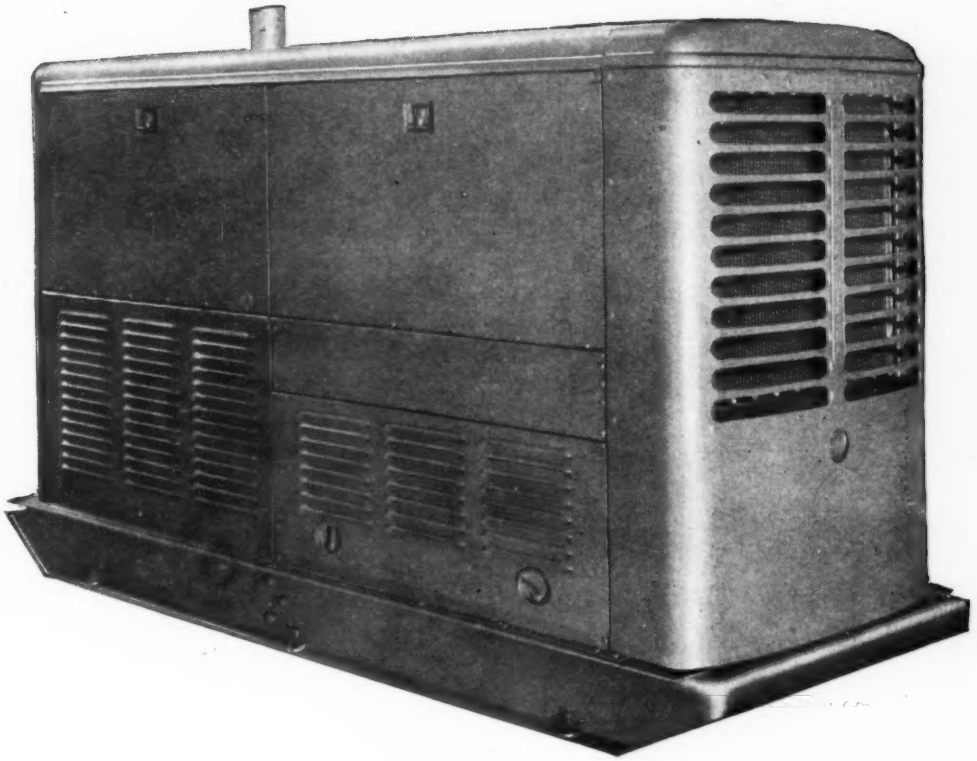
ALL REBUILT AND GUARANTEED

ROBERT SCHOONMAKER

Port Washington, Long Island, N. Y.

Phone Roslyn 1220

PORTABLE DIESEL GENERATOR SETS



15 KW 30 KW 50 KW

INTERNATIONAL UD-14—UD-18

BRAND NEW—SPOT DELIVERY

RADIATOR COOLED—SKID MOUNTED

60 cycle 127/220 volts

50 cycle 230/400 volts

SPECIAL PURCHASE BARGAIN

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Port Washington, Long Island, N. Y.

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The NEW YEAR with NEW MOTORS

DELIVERY FROM STOCK

ONE YEAR GUARANTEE

BY THE ORIGINAL MANUFACTURERS

NEW STANDARD OPEN SQUIRREL CAGE 3/60/220-440V. B.B.

Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.
	¾	204	1200	11—	7½	324	1200	3—	50	445	1800
10—	1	204	1200	5—	10	324	1800	5—	50	504	1200
10—	1	204	1800	5—	10	326	1200	5—	60	504	1800
17—	1½	204	1800	10—	15	326	1800	5—	60	505	1200
14—	1	224	1800	12—	15	365	1200	5—	75	505	1800
3—	2	224	1800	7—	20	364	1800	5—	75	5084	1200
9—	2	225	1200	11—	20	404	1200	2—	100	5084	1800
8—	3	223	1800	22—	25	365	1800	2—	100	5084	1200
6—	3	254	1200	25—	25	404	1200	2—	125	5085	1800
15—	5	254	1800	10—	30	405	1800	2—	125	6085	1200
5—	5	284	1200	6—	30	444	1200	2—	150	5085	1800
7—	7½	284	1800	5—	40	444	1800	2—	150	6085	1200
				5—	40	445	1200	2—	200	6085	1800
								2—	200	6085	1200

NEW—TOTALLY ENCLOSED FAN COOLED 3/60/220—440 V. B.B.

Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.	Quan.	H.P.	Frame	R.P.M.
21—	1	203	1800	5—	10	324	1800	5—	50	445	1800
10—	1	204	1200	5—	10	326	1200	5—	50	504	1800
30—	1½	204	1800	7—	15	326	1800	5—	60	504	1800
13—	1½	204	1200	5—	15	365	1200	2—	60	605	1200
7—	2	224	1800	6—	20	364	1800	3—	75	505	1800
27—	2	225	1200	8—	20	404	1200	2—	75	508	1200
21—	3	225	1800	8—	25	365	1800	2—	100	508	1800
6—	3	254	1200	7—	25	405	1200	2—	100	508	1200
5—	5	254	1800	6—	30	405	1800	2—	125	6085	1800
6—	5	284	1200	5—	30	444	1200	2—	125	6085	1200
5—	7½	284	1800	5—	40	444	1800	2—	150	6085	1800
7—	7½	324	1200	5—	40	445	1200	2—	150	6085	1200

NEW—D.C. MOTORS 230 V.—NEW

2—½ HP, 230 V., Shunt Sl. B, DP, TL204, 690/2760 RPM.
3—½ HP, 230 V., Shunt BB, TE, T-224, 690 RPM.
21—¾ HP, 230 V., Shunt BB, DP, T-225, 690 RPM.
21—¾ HP, 230 V., Shunt BB, DP, T-225, 690 RPM.
4—¾ HP, 230 V., Shunt SL, DP, T-224, 690/2760 RPM.
20—1 HP, 230 V., Shunt BB, DP, T-204, 1150 RPM.
1—1 HP, 230 V., Shunt SL, DP, 204, 1150/2300 RPM.
5—11/2 HP, 230 V., Shunt SL, DP, 224 1150/2300 RPM.
4—11/2 HP, 230 V., Shunt SL, DP, 225, 690/2760 RPM.
20—11/ HP, 230 V., Shunt BB, DP, 204, 1750 RPM.
20—11/ HP, 230 V., Shunt BB, DP, 224 1150 RPM.
20—2 HP, 230 V., Shunt BB, DP, 225, 1150 RPM.
13—2 HP, 230 V., Shunt BB, DP, 224, 1750 RPM.
3—2 HP, 230 V., Shunt SL, DP, 225, 1150/2300 RPM.
5—3 HP, 230 V., Shunt SL, DP, 225, 1150/2300 RPM.
1—3 HP, 230 V., Shunt BB, DP, 225, 1750 RPM.
3—5 HP, 230 V., Shunt BB, 254, 1750 RPM.
1—5 HP, 230 V., Shunt BB, Semi Enc., 254 1750 RPM.
1—7½ HP, 230 V., Shunt BB, Open 23-T, 1750 RPM.
1—10 HP, 230 V., Shunt BB, DP, 34-T, 1750 RPM.
1—7½ HP, 230 V., Shunt BB, DP 400/1600 RPM.

NEW STOCK—COMPENSATORS—STOCK NEW

50 HP 220-60-3
75 HP 220-60-3
100 HP 220-60-3
125 HP 220-60-3
100 HP 220-25-3
50 HP 440-60-3
75 HP 440-60-3
100 HP 440-60-3
125 HP 440-60-3
150 HP 440-60-3

NEW—SQUIRREL-CAGE GEAR MOTORS—NEW

¼ HP Master 220/440/60/3 390 RPM
¼ HP Master 220/440/60/3 144 RPM
½ HP Bline 220/440/60/3 850 RPM
1 HP GE 220/440/60/3 484 RPM
1½ HP Master 220/440/60/3 350 RPM
1½ HP Master 220/440/60/3 383 RPM
1½ HP Master 220/440/60/3 175 RPM
2 HP Master 220/440/60/3 288 RPM
2 HP Sterling 220/440/60/3 59 RPM
3 HP Master 220/440/60/3 62 RPM
5 HP Master 220/440/60/3 85 RPM

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MONROE 1388-1389 P.O. BOX 1273 ROCHESTER 7, N.Y.

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TRANSFORMERS

1—200 KVA GE, type H.K. 2300/115/230 volts, I PH 60 cy.
2—200 KVA GE, type H Form VD 4800/8320Y/480 volts, 1 PH. 25 cy.
3—200 KVA, Gen. Elec. type A form L 2400/240/480 Volts, 1 Ph. 60 cy.
1—100 KVA GE, type H Form KDD 11000/2600 volt, 1 PH. 60 cy.
2—75 KVA West. type S.K. 1 ph. 25 cy. 60000 volts Prim-6900/2300 volts secondary.

OTHER SIZES, VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

240 KW, 8 PF Electric Machinery, 4600 volts, 60 cycle, 3 phase 450 R.P.M. with direct connected exciter.
200 KW, Westg. Unity Power Factor, 3 PH, 60 cy. 220/440 900 R.P.M. with direct connected exciter.
150 KVA Gen. Elec. Type ATB form D 60, 3 ph., 220/440 600 with Rev. Field and built in Exc.

MOTOR GENERATOR SETS

Western Elec. 1000 Amps—40 volts direct con. to either AC or DC 580 RPM Motor

IND. FREQUENCY CHANGER SETS

ALL SIZES VOLTAGE AND CYCLES

SYN. FREQUENCY CHANGER SET
Motor 850 HP—2300 Volts—25cy—3 PH. 750 Speed
GEN 750 KVA 2300 Volts 62½ Cy. 3 PH. 750 Speed
with Bolted Exciter and Control.

3 ph. 25 cy. Motors

H.P.	Make	Type	Speed	Volt
350	Gen. Elec.	St. Rg. 3 Brg. I	375	400
250	Gen. Elec.	S. R. I. M.	500	440
200	Lincoln	S. R. I. X. W.	500	400
100	West.	Syn. Stator and Rotor H. R.	300	2200
100	Wagner	Sl. Rg. BR	750	220/440
70	Gen. Elec.	Syn. Stator and Rotor ATI	167	2200

3 ph. 60 cy. A.C. Motors

H.P.	Make	Type	Speed	Volts
250	West.	Slip R. CW	1800	440
200	West.	Syn.-Dir. Con. Ex. P. F. 08	900	220/400
200	Gen. Elec.	Syn. ATI	514	400/2300
150	Gen. Elec.	Syn. Stator and Rotor ATI	400	2200
25	Gen. Elec.	Sq. Cg. I. K. Vert.	720	2200

230 Volt D. C. Motors

H.P.	Make	Type	Speed
75	Crocker Wh.	CCM25JA	700
60	Sprague	D — Comp. Wound	625
40	Fair Morse	Ball BRG. Vert. Comp.	1740

125 Volts D. C. Motors

H.P.	Make	Type	Speed
60	Allis Chalmers	FB131-Comp. V. B. Pipe Vent.	1755

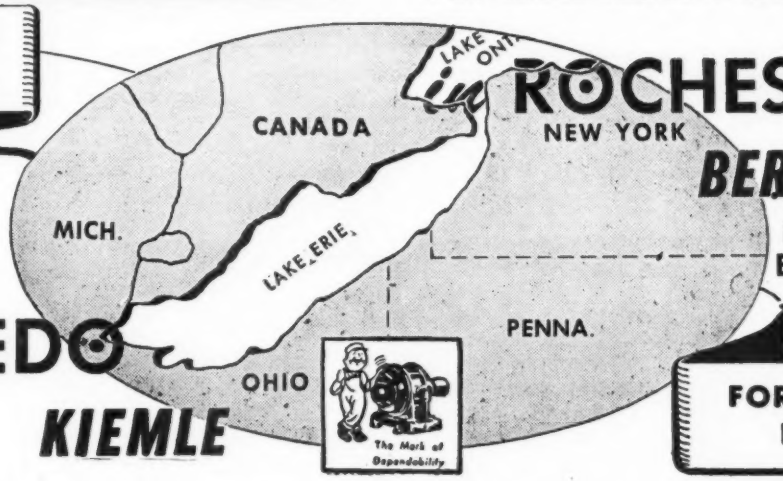
550 Volt D. C. Motors

H.P.	Make	Type	Speed
35	West.	Sk 150 Shunt Int.	850

D. C. GENERATORS

150 KW Western Elec. 3 brg. 3 wire, 115 230 V. 600 R.P.M.
50 KW—Northern—Comp. 110 V.—700 R.P.M.

OVER 10,000 STOCK ITEMS



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395 STATE ST.
ROCHESTER 4
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FOR IMMEDIATE DELIVERY

TRANSFORMERS

3—500 KVA, GE., type H, form VDJ 46000/23000 to 2300 1 phase 25 cycle.
3—50 KVA Pittsburgh 60 cycle, 1 Ph. 440/110/220 volts.
3—50 KVA Maloney, type H.F.B. 1 Ph. 60 cy. 3600/240/480 Volts.
1—50 KVA Maloney Type HFB 1 Ph. 60 cy. 3000/120/240 Volts.

OTHER SIZES, VOLTAGE AND CYCLES AVAILABLE

ALTERNATORS

10 K.W. Gen. Elec. 1 Ph. 60 Cy. 220 Volts—1800 R.P.M.

75 K.W. Modern West. Type S.K. Comp. WD. Int. 230 Volts—Generator Direct-Con. to 3 P.H. 60 Cy. 440 Volts 1200 RPM. Syn. Motor (3 Bearing) Factory Built With Control Panel.

WEST. D.C.—VARIABLE SPEED MOTORS
10—10 H.P. Type S.K. 230 V. 500/1500 R.P.M. with Automatic Dynamic braking Starters and Field Rheos.

SYNCHRHONOUS—CONVERTER
300 KW Gen. Elect. Synchronous Converter, 6 Phase, type HCC form J, 25 cycle 750 speed with transformers for 2300 volts to 230 volts D.C.

3 ph. 60 cy. A. C. Motors

H.P.	Make	Type	Speed	Volts
500	Electric Mach.	Syn. Stator and Rotor	257	440
200	Wsghse.	Sl. Rg. CW	600	220/440
150	Gen. Elec.	S. R. I. M.	400	400
100	Lincoln	M.	1150	440
100	Allis Ch.	S. R. A. N. Y.	600	440

3 ph. 25 cy. Motors

H.P.	Make	Type	Speed	Volts
100	Allis. Ch.	S. R.	1750	440
75	Gen. Elec.	Var. BTA	375–750	440
75	Gen. Elec.	S. R. I. M. 17B	160	440
75	Gen. Elec.	Sl. Rg. I. M.	760	220/440

230 Volt D. C. Motors

H.P.	Make	Type	Speed
150	West.	SK 180L Comp. Wd. Int.	1150
60	Gen. Elec.	C-Shunt Wd.	600
50	Crocker Wheeler	CM	625

Rebuilt and Sold with a Standard New Guarantee

Put all idle equipment to work. Send your list for prompt action. WRITE OR WIRE YOUR INQUIRIES

Above KIEMLE OFFERS

THE PICK OF POWER EQUIPMENT

TURBINE UNITS—60 Cy.

1—22500 KW General Electric Cond.
1—15300 KVA Westinghouse Cond.
1— 7500 KVA General Electric Cond.
1— 5000 KVA General Electric Cond.
1— 3750 KVA Westinghouse Extrac.
1— 3125 KVA Westinghouse Cond.
1— 2500 KVA General Electric Cond.
1— 1563 KVA General Electric Cond.
1— 1563 KVA Westinghouse Extrac.
1— 625 KVA General Electric Cond.
2— 625 KVA General Electric Non-C.

D. C. TURBO UNITS

1—125 KW General Electric, 125 V.
1— 75 KW General Electric, 125 V.
1— 25 KW Westinghouse, 125 V.

STEAM ENGINE UNITS—60 Cy.

1—1067 KVA Nordberg Uniflow
1— 625 KVA Ames Uniflow
2— 480 KVA Skinner Uniflow
1— 375 KVA Harrisburg Uniflow
1— 325 KVA Skinner Uniflow
1— 300 KVA Skinner Uniflow
1— 150 KVA Skinner Uniflow

D. C. STEAM ENGINE UNITS

1—500 KW Ames Uniflow 250 V.
1—400 KW Ridgway 4-valve 275 V.
1—350 KW Ridgway Uniflow 250 V.
1—300 KW Skinner Uniflow 275 V.
1—125 KW Ridgway 4-valve 250 V. 3-wire

DIESEL ENGINE UNITS

1—1400 HP Fair.-Morse, 2300 V. 60 cy. gen.
3— 700 HP Enterprise, 2400 V. 60 cy. gen.
1— 625 HP Worthington, 240 V. 60 cy. gen.
1— 440 HP Nordberg, 250 V. DC Gen.
2— 400 HP LeRoi RX1SV (gasoline) eng. only.
1— 375 HP McInt. & Sey., 240 V. 60 cy. gen.
1— 300 HP McInt. & Sey., 480 V. 60 cy. gen.
1— 150 HP Buckeye 400 RPM engine only
2— 125 HP Winton, 240 V. 60 cy. gen.

WATER TUBE BOILERS

4—1373 HP B. & W. 230-lb., Oil Fired
1—1302 HP Springfield 400-lb., Pulverizer
2— 760 HP Stirling 250-lb., Stokers
2— 617 HP Wickes, 250-lb., Bent Tube
1— 607 HP Wickes 250-lb., Stoker
6— 600 HP B. & W. 200-lb., Stokers
2— 560 HP Erie City 460-lb.
2— 481 HP Springfield 225-lb., Pulverizer
2— 405 HP Erie City 160-lb., Stokers
2— 300 HP B. & W. 160-lb.

SYNCHRONOUS MOTORS

1—600 HP G. E. 60 cy. 2200 V. 600 RPM
1—500 HP Al.Ch. 60 cy. 2300 V. 450 RPM
1—375 HP G. E. 60 cy. 2300 V. 1800 RPM
2—250 HP G. E. 60 cy. 2200 V. 225 RPM
1—200 HP Ideal 60 cy. 4000 V. 514 RPM
1—100 HP G. E. 60 cy. 2300 V. 240 RPM (Super)

INDUCTION MOTORS—60 Cy.

1—2850 HP West. slip ring 6600 V. 450 RPM
1—2500 HP G. E. slip ring 6600 V. 253 RPM
1—1000 HP West. slip ring 2200 V. 360 RPM
1— 400 HP G. E. slip ring 3800 V. 1800 RPM
1— 300 HP West. slip ring 440 V. 1200 RPM
1— 150 HP G. E. slip ring 440 V. 450 RPM
2— 100 HP G. E. sq. cage 440 V. 720 RPM

MOTOR GEN. SETS—60 Cy.

1—1000 KW General Electric 600 V. DC
1— 300 KW Westinghouse 600 V. DC
1— 150 KW Westinghouse 250 V. DC
1— 100 KW Westinghouse 125 V. DC
1— 75 KW General Electric 125 V. DC

ROTARIES—60 Cy.

2—2600 KW General Electric 300 V.
1—2000 KW General Electric 600 V.
2—1750 KW General Electric 250 V.
1—1500 KW Westinghouse 250 V.
2—1000 KW Westinghouse 250 V.
1— 500 KW General Electric 250 V.

FREQUENCY CHANGERS

2—12500 KW G. E. 60/25 cy. 300 RPM
2— 3125 KVA West. 25/62½ cy. 750 RPM
1— 1875 KVA G. E. 25/60 cy. 300 RPM
1— 1500 KW West. 25/60 cy. 300 RPM
1— 1000 KVA Al.Ch. 25/62½ cy. 375 RPM

TRANSFORMERS—1 Ph. 60 Cy.

4— 500 KVA West. 110,000-2300 V.
3— 3333 KVA Moloney 66000/33000-13200 V.
1— 1500 KVA Pitts. 66000-33000 V. 3 ph.
3— 750 KVA Pitts. 66000-33000 V.
3— 100 KVA G. E. 66000-69000/11000 V.
3—1667 KVA G. E. 44000-2300/4000 Y. V.
3—1000 KVA G. E. 44000/22000-480 V.
1— 7500 KVA West. 33000-13800 V. 3 ph.
3— 833 KVA Al.Ch. 34460-4800/2400 V.
3— 200 KVA G.E. 33000-2300/4000 Y V.
3— 150 KVA G.E. 33000-2300 V.
14— 75 KVA G.E. 33000-2400 V. New
40— 50 KVA G.E. 33000-2400 V. New
50— 25 KVA G.E. 33000-2400 V. New
2—10000 KVA West. 26400-4560 V. 3 ph.
1— 6000 KVA West. 26400-2300 V. 3 ph.
4— 400 KVA Pitts. 22000/11000-2200 V.
3— 200 KVA G.E. 22000-230/460 V.
1—10000 KVA West. 13200-4560 V. 3 ph.
3— 1667 KVA Pitts. 13200-2300 V.
4— 1250 KVA Pitts. 13500-230/460 V.
3— 200 KVA G.E. 13200-480 V. Pyranol
3— 100 KVA West. 13200-2300 V.
3— 150 KVA G.E. 4150-220 V. 3 ph.

OIL CIRCUIT BREAKERS

2—1000 A. 30 KV Kelman CB76	Outdoor
1— 400 A. 25 KV G.E. FK0136	Outdoor
2— 600 A. 15 KV G.E. FK037	Outdoor
1— 600 A. 15 KV West. 0-221	Outdoor
2— 400 A. 15 KV G.E. FHK0136	Outdoor
3— 400 A. 7.5 KV G.E. FK0227	Outdoor
2—1200 A. 7.5 KV G.E. FK132B	Indoor

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & CO., INC.

50 Church Street — New York City 7, New York

BRONZE IRON **PUMPS** ALLOY METALS
ELECTRIC—STEAM—GASOLINE DRIVEN.
All Makes — Capacities — Pressures.
Centrifugal—Rotary—Plunger—Turbine.

MOTORS 1-2-3 PH. & D. C.
STANDARD EQUIPMENT—UP TO 200 H.P.
Generators—Welders—Dynamos.
New & Rebuilt Guaranteed Machines.

TURBO BLOWERS
SPENCER—INGERSOLL RAND—ALLEN BILLMYRE. For Heat Treating—Brazing Furnaces—Smelting—Vacuum Duty Etc.

TURBINE PUMP
BOILER FEED
VERTICAL ENGINE
VACUUM RETURN
STEAM UNITS

AIR COMPRESSORS
ALL TYPES—CAPACITIES 1 to 1000 "CFM"
Electric—Gasoline—Steam Driven.
For Industrial—Mine Construction.

VACUUM UNITS
FOR STEAM — AIR — GAS — FLUIDS.
All Makes—All Capacities—Tested.

FANS—EXHAUSTERS
CAPACITIES FROM 25 to 100000 CFM.
VENTILATING — SUCTION — BLOWING.
Air—Dust—Gases—Steam Vapors.

MACHINERY
CHEMICAL & INDUSTRIAL EQUIPMENT.

SUPERIOR EQUIPMENT CO.
138 Grand St., N. Y. C. Tel. CAnal 6-6983-4

TURBO GENERATORS

750 KW., 3 ph., 60 cy., 480V. 3600 Allis Chalmers to a Moore extraction type Turbine with board.

500 KW., 3 ph., 60 cy., 4800V. Westgh. non cond. Turbo Generator with board.

937 KVA., 3 ph., 60 cy., 2300V. Gen. Elec. cond. Turbo Generator.

ROTARY CONVERTERS

1—1500KW 250V Westgh complete

2—1000KW 250V Westgh complete

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, Transformers, Circuit Breakers, etc. Please send us your inquiries.

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Reconditioned Motors, Generators, Control Equipment, etc.
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COMPRESSORS
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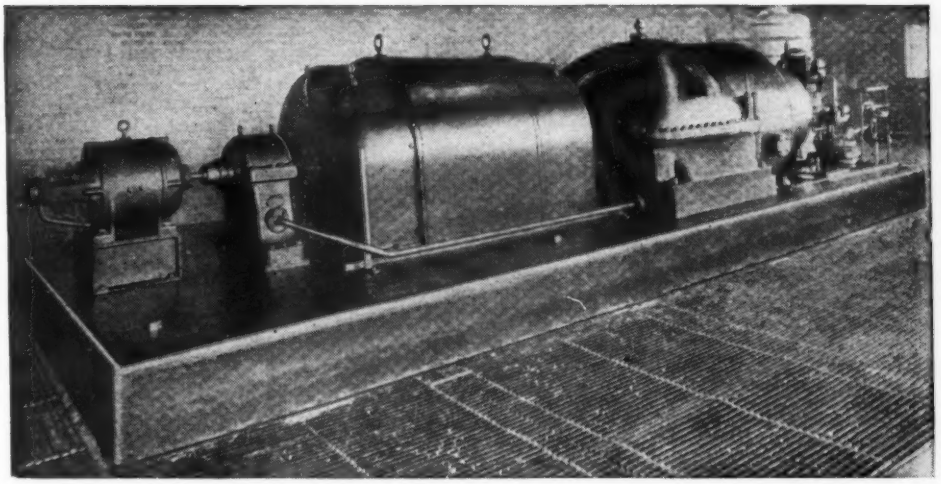
New and Guaranteed Rebuilt
Modern Plant doing Modern Rebuilding
From 50 CFM to 2500 CFM
AMERICAN AIR COMPRESSOR CORP.
Dell Ave. & 48th St., North Bergen, N. J.

TURBO-GENERATORS



Units Noted Below Are Now In Our Stock—All Are 3 Phase, 60-Cycle, 3600-RPM

7500—KVA. G.E. Sur. Cond., 190/375#: 2300-v.
6250—KVA. G.E. Sur. Cond., 200, 2300#-v.
5000 KVA. G.E., Sur. Cond., 200/400#: 2300/4000-v.
3750—KVA. G.E. Sur. Cond., 200#, 2300-v.
3125—KVA. G.E. Sur. Cond., 200#, 2300-v.
2500—KVA. G.E. Sur. Cond., 200#, 2300-v.
2000—KVA. G.E., Non-cond. 200#, 2300-v.
1875—KVA. G.E., COND. 200#.
1875—KVA, Elliott 300#-G, 2300-v.
1565—KVA. G.E. Sur. Cond. 150#, 2300
1250—KVA, Westinghouse, 200#, 2300-v.
1250—KVA, Allis-C. Non-cond. 150#, 840-v.
1250—KVA. West. Sur. Cond. 200#, 2300
1250—KVA, Allis-C. Non-cond. 150#, 480-v.
937—KVA. Allis-C. Cond. 200#.
937—KVA, G.E., 200#, Cond. 2300-v.
625—KVA, G.E., 200#, 2300-v.
375—KVA. G.E., Cond. 200#, 2300-v.

WILMS, WEAVER & CO.

Steam Turbine-Generator Specialists

4045 Penobscot Building . **Detroit (26) Michigan**

FOR SALE
150 & 100 KW, 220 V. AC Gens. D/C 4-Valves
210 KW, 250 V. DC Gen. D/C 4-Valve Engine
75 & 50 KVA Generators D/C Steam Engines
24"x36" Jaw Crusher with Bucket Elevator
4000' Air Compressor & 750 HP Diesel Eng.
40, 60, & 150 KVA Gens. D/C Full Diesels
75'x140' Steel Building—4 yrs. old
300 KVA Generator D/C F-M Full Diesel
H. & P. MACHINERY CO.
6719 Etzel Ave., St. Louis 14, Mo.

APPLICATION ENGINEERS
2—200 KW Syn. M. G. Sets 440 AC—250 DC.
96 and 48 KW—240 V. AC uniflow engine sets.
375—KVA—480 V. 4-Valve Ball engine set.
120 HP Fairbanks Morse diesel engine.
3000 HP—120 rpm GE slip ring motor and control.
Complete diesel plant (3) 180 HP 240 V. AC units.
All Inquiries Receive Prompt Attention.
HOWARD B. JOHNSON & ASSOCIATES
53 W. Jackson Blvd. Chicago 4, Ill.

DIESEL GENERATOR UNIT
1500 H.P.—1250 KVA
Nelseco — General Electric
Modern, Supercharged, Bosch Injection
3/60/2400, 300 RPM, All Accessories, Complete
Immediate Stock Delivery Rebuilt
A. G. SCHOONMAKER COMPANY
50 Church St., New York 7, N. Y.
Phone Worth 2-0455

POWER PLANT EQUIPMENT CO., Inc.

39 Cortlandt Street
New York, N. Y.

A.C. TURBINE UNITS
5000 KVA GE 2300/4000 v. (bleeder)
3750 KVA GE 2300 v. Cond.
1560 KVA Wghse 480 v. (bleeder)
1556 KVA Al. Chal. 2300 v. Cond.
937 KVA G.E. 2300 v. Cond.
750 KVA G.E. 2300 v. Cond.
625 KVA Wghse. 480 v. (bleeder)
625 KVA G.E. 2300 v. Cond.
625 KVA Ridge. 400 v. Non-Cond.
375 KVA G.E. 480 v. Cond.
375 KVA G.E. 2300 v. Non-Cond.
115 KVA Wghse.-Sturd. 240 v. Non-Cond.
50 KVA Terry 480 v. Non-Cond.

UNIFLOW UNITS
750 KVA G.E.-Filer Stowell
350 KVA G.E.-Ames
240 KVA Ridge.-Ridge.
180 KVA W.E.-Chuse 4 v.
166 KVA Al. Chal.-Ames

W. T. BOILERS
1047 HP. (2) Heine 250#
759 HP. (2) Sterling 250#
612 HP. Sterling 200#
522 HP. Kidwell 207#
403 HP. Sterling 250#
400 HP. (2) Heine 190#
317 HP. (2) Heine 250#
305 HP. Kidwell 200#
300 HP. Murray 180#
260 HP. Kidwell 207#

DIESEL ENGINE UNITS
1500 KVA Wghse.-Am. Loco.
737 KVA Wghse.-Am. Loco.
375 KVA G.E. (2)-Worthington
225 KVA W.E.-Worthington
125 KVA W.E.-Worthington

SYNCHRONUOUS CONDENSER
500 KVA G.E. 4150/2300 v.

PUMPS (MOTOR DRIVEN)
3000 GPM Al. Chal. 65' hd.
1000 GP. Al. Chal. 246' hd.

AIR COMPRESSORS (MOTOR DRIVEN)
8x8 Sullivan 100#
400 CFM Sullivan 100#

CHICAGO'S LARGEST STOCK GUARANTEED EQUIPMENT

MOTOR-GENERATOR SETS

KW	Make	DC	Volts	AC Volts
1000	Wtg.	275	Ind.	3/60/4100
750	Elliott	275	Syn.	3/60/440
300	G.E.	275	Syn.	3/60/2200
225	Ideal	115	Syn.	3/60/2200
200	G.E.	250	Syn.	3/60/440
150	G.E.	250	Syn.	3/60/2300
100	G.E.	3 wire	Syn.	3/60/480
75	G.E.	125	Ind.	3/25/220
75	G.E.	125	Ind.	3/25/440
90	Wtg.	110	75 KVA	3/60/2300
60	Al.Ch.	110	Ind.	3/60/2300
50	G.E.	115	Ind.	3/60/440
35	G.E.	250	Ind.	3/60/220
35	Century	240	Syn.	3/60/240

SLIPRING MOTORS
3 phase, 60 cycle

HP	Make	Type	Volts	Speed
800	Wtg.	CW	6600	507
600	Al. Ch.	ANY	2200	1180
600	Wtg.	CW	2300	343
350	Wtg.	CW	220	700
350	G.E. 3b.	IM	2200	600
300	G.E.	IM	2200	514
300	G.E.	MT	2000	450
200	F. Morse		440	600
300	Al. Ch.		440	705
250	G.E.	IM	440	720
250	G.E.	IM	2200	600
200	Ideal	AV	440	600
150	Al. Ch.	ARY	440	880
150	Wtg.	CW	440	600
100	G.E.	IM	2200	1800
100	Wtg. vert.	CW	2200	1160
100	Ideal	AV	2200/440	720
100	Westg.	HF	440	230
75	G.E.	MT	220	1800
75	G.E.	MT	440	860
60	Al. Ch.	ARY	220	690
60	G.E.	MT	440	1800
60	G.E.	IM	220	900
60	Al. Ch.	ARY	220	690
60	G.E.	MT	2200	600
50	Wtg.	CW	440	570
40	Wagner	TBR	440	1750
40	Al. Ch.	ARY	220	1160
30	G.E.	MT	440	1150
30	Wtg.	CW	220	865
35	G.E.	IM	220	1140
25	G.E.	IM	220	855

This is a partial listing only

SQUIRREL CAGE MOTORS
3 phase, 60 cycle

HP	Make	Type	Volts	Speed
350	G.E.	KT	440	1765
150	G.E.	I-K	440	1800
150	G.E.	K	440	1200
150	G.E.	I-K	3b.	600
100	G.E.	KT	440	3450
150(6)	Al. Ch.	AR	440	900
150	Wtg.	CS	2200	720
150	Al. Ch.		440	570
150	G.E.	IK	440	575
100	Wtg.	CS	2200	1750
100	Wtg.	CS	440	900
100	Wtg.	CS	2200	870
75	G.E.	KT	2200	1800
75(9)	Al. Ch.	AR	2200	1765
75	Westg.	CS	2200	870
75	G.E.	KT	440	870
75	Wtg.	CS	220	600
60	G.E.	KT	440	865
60	Wtg.	CS	220	435
60	Wtg.vert.	CS	2200	1750
50	G.E.	KT	440	900
50	G.E.	IK	440	1200
40	G.E.	KF	2200	1745
40	G.E.	KT	220	1745
40	Wtg.	C	440	850
40	Al. Ch.		440	850
40	F. Morse	H	2200/440	720
40	Al. Ch.		440	570
35	G.E.	IK	440	1200
35	Wtg.	CS	2200	1175
35	G.E.	KT	220	900
35	G.E.		2200	900
35	Al Ch.		440	680
30	G.E.	KF405 t.e.f.r.	220	1760
35	Al. Ch.		440	480
30	G.E.	KT	220	860
30	G.E.	KT	440	900
30(2)	Wtg.	CCL	220	840
30(2)	Al. Ch.		640	860
30	G.E.	KT	220	600
25	Ideal	AA80	220	1740
25	Cr. Wh.	118Q	440	1150
20	G.E.	KF364	220	1760

This is a partial listing only, have NEW from ¼ to 60 hp right in stock.

A. C. .GENERATORS

KW	Make	Volts		Speed
300	G.E.	480		900
200	Westg.	2400		900
75	Burke	AC16	240	1200
72	F. Morse	AB	440	900
75	G.E.	ATB	230	1200
60	F. Morse	D	2300	300
8	G.E.	ATI	240	900

TRANSFORMERS

KVA	Make	Pri. V.	Sec. v
2— 667	Moloney	13200	460
2— 500	G.E.	33000	480
1— 100	G.E. 3 ph.	9000	230
3— 75	Wtg.	3810	244/122
2— 50	G.E.	2200	440/220
1— 20	G.E.	2200	220/440
1— 15	G.E.	1050/2100	2200/288
1— 15	G.E.	2400	120/240
1— 7½	G.E. 3 ph.	2200/3810	220/440
1— 7½	G.E.	1100/2200	220/440
1— 6	Kuhlman	100	20
1— 5	Sorgel	140	220
1— 5	G.E.	1100/2200	110/440
1— 5	G.E.	1100/2200	220/440
5— 3	G.E.	440	110/55
1— 3	Moloney	1150	115/230

Also New, All Kinds

BOILERS

2—800 "Twin setting" B & W Stirling ASME, 200 lbs. all complete, excellent condition.

2—400 hp. Casey Hedges, water tube Boilers, oil burning, 150 lbs.

FREQUENCY CHANGER

1—1400 HP General Electric type ATI-24-1250M-300, form C, 3 ph. 60 cy. 460 volt, 300 RPM, 1570 amps, 1250 KVA, 0.9 P.F. 50° synchronous motor with amort. wdg.; dir/conn. to 1000 KW General Electric type ATI-18-1250M-300, 3 ph. 25 cy. 460 volts, 300 RPM, 1570 amps, 1250 KVA, 0.8 P.F. 50° A.C. generator with amort. wdg., with 33 KW G.E. 125 volt direct connected exciter. (This is a three brg. unit suitable for operation from either end.)

SYNCHRONOUS MOTORS
3 phase, 60 cycle

HP	Make	Type	Volts	Speed
1000	Wtg.		440	900
750	Al. Ch.		440	1200
750	G.E.	conds.	550	900
500	G.E.	TS	2300	450
300	G.E.	conds.	480	900
270	G.E.	ATI	440	600
150	Burke	81375	2200	600
100	Cr. Wh.		240	900
75	G.E.	ATB	220	1200
50	El. M.	.8	240	1200
10	G.E.	ATI	240	900
5	G.E.	K324 reluctance type	220	1800

VARIABLE SPEED
D. C. Motors

HP	Make	Type	Speed
100	G.E.	C	1100/1200
25	Wtg.	S9	550/780
25	G.E.	DLC	500/1000
20	Wtg.	SK113	500/1000 (4
15	G.E.	RC16	500/700
15	G.E.	CE	650/950
14	G.E.	C	700/1400
12	Wtg.	SK80L	500/1000(2)
10	El. Dyn.		600/1200
12½	G.E.	C	700/1400
	G.E.	C	800/1400
5	Burke	AM12	500/1500
5	Burke	WAM12	650/1950

WE ARE ALWAYS IN THE MARKET FOR ALL TYPES OF GOOD MODERN ELECTRIC MOTORS, MOTOR - GENERATOR SETS GENERATORS, TRANSFORMERS, AND OTHER ELECTRICAL EQUIPMENT. SEND US YOUR LISTS FOR BEST CASH OFFERS.

CHICAGO ELECTRIC CO. 1320 W. CERMAK RD. CANAL 2900 CHICAGO 8, ILL.

IMMEDIATE DELIVERY FROM STOCK
TURBINE—GENERATOR UNITS

4375 KVA G.E. condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 200# pressure, equipped with condenser and auxiliaries.

3125 KVA G.E. condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 225# pressure, 500° TT, equipped with either a surface or jet condenser, switchboard and instruments.

1875 KVA G.E. condensing, 3 phase, 60 cycle, 6600 volts, 3600 RPM, 200#, 500° TT, complete with condenser.

1875 KVA Westinghouse condensing, 3 phase, 60 cycle, 480 volts, 3600 RPM, 175-200# pressure, 500° TT, complete with turbine driven exciter set, switchboard, Westinghouse jet condenser and condensing auxiliaries.

1875 KVA Elliott condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 300# pressure, 225°F. superheat, complete with shaft exciter, switchboard, condenser and condensing auxiliaries.

1250 KVA Westinghouse condensing, 3 phase, 60 cycle, 2400 volts, 3600 RPM, 200# pressure, equipped with direct connected shaft exciter, condenser, switchboard and instruments.

1250 KVA Westinghouse non-condensing, 3 phase, 60 cycle, 480 volts, 3600 RPM, 200-250# pressure, 500° TT, 15 lbs. gauge back pressure, complete with switchboard panel and instruments.

940 KVA Westinghouse condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 250# pressure, 500° TT, complete with direct connected exciter, surface condenser and auxliiaries.

937 KVA G.E. condensing, 3 phase, 60 cycle, 2300 volts, 3600 RPM, 175#, complete with shaft exciter, surface condenser.

780 KVA Westinghouse non-condensing, 3 phase, 60 cycle, 480 volts, 3600 RPM, 175-200# pressure, 15 lbs. back pressure, complete.

625 KVA Westinghouse condensing, 3 phase, 60 cycle, 2400 volts, 3600 RPM, 200# pressure, equipped direct connected shaft exciter, condenser, switchboard and instruments.

375 KVA G.E. condensing 3 phase, 60 cycle, 2300 volts, 3600 RPM, 150-200 lbs. pressure, 100° SH, complete with surface condenser.

125 KVA Westinghouse non-condensing, 3 phase, 60 cycle, 240 volts, 3600 RPM, 175-200# pressure, 0-10 lbs. gauge back, complete with direct connected exciter and switchboard.

125 KVA G.E. non-condensing, 3 phase, 60 cycle, 240 volts, 3600 RPM, 125#, 10# gauge back, complete with direct connected exciter.

Utilities Electrical Machinery Corporation

600 NATIONAL CITY BANK BLDG
CLEVELAND 14, OHIO

WIRE OR PHONE
LONG DISTANCE 422

WAGNER

"Certified Rebuilt" ELECTRICAL APPARATUS

M-G SETS

300 KW Gen. Elec. type MPC gen. DC 170 volts 1760 amp. coupled to 450 HP G.E. MPC motor DC 250 V. 1150 RPM (can furnish A.C. drive).
100 KW Gen. Elec. 3 brg. unit, type RC gen. DC 125 v. coupled to 150 HP sq. cage 1-K motor 3-60-2200/4000 V.—1200 RPM.
50 KW Cr. Wheeler type CC generator DC 125 V. coupled to 80 HP C-W motor sq. cage 3-60-220/440 V. 1800 RPM.
40 KW Whse. SK gen. DC 250 V. coupled to 75 HP Ideal synch. motor 3-60-220/440 V.—1200 RPM.
35 KW Gen. Elec. DLC gen. DC 250 V. to 50 HP AC motor 3-60-220/440 V.
30 KW Gen. Elec. CD 103 gen. DC 60 v. 500 amp. coupled to 45 HP G.E. KT 532 motor 3-60-220/440 v. 1160 RPM, late style 3 brg. unit.
19 KW Gen. Elec. CD95 gen. DC 65 V. 300 amp. to 30 HP G.E. KT motor 3-60-220/440 V.
Others available—special units built to order.

D. C. MOTORS

H.P.	Mfg.	Type	Volts	Speed
450	Gen. Elec.	MPC	230	1150
75	Whse.	S13	125	475
75	Gen. Elec.	DLC	230	400
50	G.E. Sprague	LC	250	700/2000
50	Whse.	SA	230	450/1350
40	Gen. Elec.	DLC	230	750
40	Roth	S	115	850
40	Whse.	SK	230	900
30	Allis Ch.	E100	230	1800
30	Sprague	LC	230	600/1200
30	Sprague	dynamom	250	800/2000
25	Gen. Elec.	DLC	115	750
25	Roth	elevator	230	725
25	Whse. enclosed	SK	230	600
25	Louis Allis b. b.	NA	230	1800
25	Gen. Elec.	RC32	230	800
20	Imperial Int.dty	D37	230	1200
20	Gen. Elec.	RF12	230	400/1200
20	Gen. Elec.	DLC	230	500/1500
20	Whse.	SK100L	230	900

OUR 40th ANNIVERSARY— 1906 1946

SQUIRREL CAGE MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
2	150	Gen. Elec.	I-K	900
1	100	Allis Ch.	AN	900
2	75	Gen. Elec. b.b.	K445	1800
1	75	Allis Ch.	AN	720
1	60	Gen. Elec. b.b.	K444	1800
2	50	Gen. Elec. b.b.	K405	1800
2	50	Gen. Elec. vertical	KT	1200
2	40	Allis Ch.	AN	1200
2	40	Whse. b.b.	CS444	1800
1	40	Gen. Elec.	KT332	1200
1	35	Allis Ch.	AN	900
3	30	Gen. Elec.	K365	1800
2	30	G.E. TEFC b.b.	KF405	1800
2	30	G.E. TEFC b.b.	KF444	1200
1	30	F. Morse TEFC b.b.	QZC444	1200
2	30	Allis Ch.	AN	1200
3	30	Allis Ch.	AN	900
9	25	Gen. Elec. b.b	KTR526	1200
3	25	Whse. New	CS365	1800
1	25	Gen. Elec.	KT322	1200
2	25	Allis Ch.	AN	900
1	25	Whse.	CS	720
1	25	G.E. splash. b.b.	KF365	1800
2	20	L. Allis splash. b.b.	FX364	1800
4	20	G.E. splash. b.b.	K405	900
4	20	Allis Ch.	AN	900
2	20	Gen. Elec.	I-K	1200
1	20	Ideal	AA	1200
3	20	Gen. Elec.	KT312	1200

25 CYCLE MOTORS

HP	Mfr.	Type	Speed
450	Whse. 2200 v.	CW sl. rg.	750
300	Whse.	CW sl. rg.	500
150	Whse.	HD sl. rg.	500
150	Gen. Elec. 2200 v.	MT359 sl. rg.	1500
100	Whse.	CCL sq. cg.	500
100	Gen. Elec.	I-K	750
100	Gen. Elec.	I-Ksq. cg.	500
50	Allis. Ch.	ANY sl. rg.	1500

SYNCHRONOUS MOTORS

H.P.	Mfr.	Type	Volts	Speed
750	Allis Ch.		220/440	1200
350	Gen. Elec. 3 brg.	ATB	220/440	600
300	Whse.	ped.	220/440	900
290	Gen. Elec.	ATI	220/440	600
250	Gen. Elec.	ATI	220/440	514
250	Gen. Elec. 1 brg.	ATI	220/440	600
75	Ideal	SMS	220/440	1200
40	Gen. Elec. 8. PF	TS	220/440	900

CENTRIFUGAL PUMPS

14" Foster Wheeler, 5000 gpm @ 45 ft.
10" Weinman, 2500 gpm @ 40 ft.
8" Alberger, 200 gpm @ 80 ft.
6" Platt, 1000 gpm @ 230 ft.

SLIP RING MOTORS

3 Phase—60 Cycles—220 or 440 Volts

Qua.	H.P.	Mfr.	Type	Speed
1	350	Whse. 2200 v.	CW	720
1	300	Burke	EMV	225
1	300	Whse.	HF	400
1	300	Gen. Elec.	MT410	450
1	300	Gen. Elec.	I-P	720
1	250	Gen. Elec.	I-M	720
1	250	Gen. Elec.	I-M	600
1	200	Gen. Elec.	I-M	600
1	175	Whse.	MW	450
1	150	Gen. Elec.	MT562	720
2	100	G.E. 2200 v.	I-M	900
1	75	Gen. Elec.	MT537	1800
1	75	G.E. 2200 v.	I-M	900
1	75	G.E. 2200 v.	I-E13	1800
1	75	P. & H. b. b. Int.	CA16	900
1	60	Whse. 2200 v.	CW657	1800
2	60	Gen. Elec.	M-505	1200
1	50	Gen. Elec.	MT536	1200
1	50	Gen. Elec.	I-M	600
1	40	Gen. Elec. 2 ph.	MQ536	900
1	40	North'n	HW35A	900
2	40	Gen. Elec.	MT532	1200
1	40	Fair. Morse b. b.	HV	1200
1	40	Whse.	CW	900
2	40	Gen. Elec.	M546	514
2	40	Allis Ch.	ANY	450
1	40	G.E. 550 v.	MT536	900
1	35	Fair. Morse b. b.	HV	1800
1	30	Northwestern b. b.	HW404	1800
2	30	Allis Ch.	ANY	900
2	30	Whse. enclosed	MA	600

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Gen. Elec. 1 brg.	MPC	125/170	1150
75	Whse.	S	125	600
60	Gen. Elec.	DLC	250	450
50	Cr. Wheeler	CC	125	1800
35	Gen. Elec.	DLC	250	900
30	Lincoln b. b. 600 amp.		50	1200
25	Gen. Elec.	DLC	125	900
25	Gen. Elec.	LC	250	900
20	Whse.	SK	250	1200
19	Gen. Elec. 300 amp.	CD	65	1200
16	Cr. Wheeler	CCD	125	415

ALSO IN STOCK . . . OIL SWITCHES
BLOWER & FANS . . . SPEED REDUCERS . . . 500 NEW MOTORS

60 CYCLE A.C. GENERATORS

KVA	Mfr.	Type	Volts	Speed
500	Gen. Elec. 3 brg.	ATB	2300	450
300	Gen. Elec. 3 brg.	ATB	240/480	600
300	Whse.	ped.	240/480	900
300	Elec. Machy. 3 brg.		240/480	720
250	Gen. Elec. 1 brg.	ATB	240/480	600
150	Allis Ch.		2300	900
150	Allis Ch. 25 cycle		240/480	500
100	Cr. Wheeler	ped.	240/480	600

ARTHUR WAGNER COMPANY

1436-38 W. RANDOLPH STREET — CHICAGO 7, ILL. — MONroe 7409

SYNCH. CONVERTERS

500 KW AL-CH. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
150 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM

MOTOR GENERATORS

300 KW G.E. SYN. 600 V. 2300/4000 A.C. 1200 RPM
300 KW G.E. SYN. 250 V. 2300/4000 A.C. 1200 RPM
300 KW WEST. SYN. 250 V. 4000/6600 AC. 900 RPM
150 KW. WEST. SYN. 600 V. 2300/4000 AC. 1200 RPM

Each unit listed above is owned by us and is available now for immediate purchase

WALLACE E. KIRK CO.

Incorporated

502 Grant Building, Pittsburgh, Pa.

TRANSFORMERS

New or used. All types and sizes. Air and oil cooled. Phase changers a specialty.

ATLANTIC TRANSFORMER CO.
Transformer Specialists
5143 N. 2nd St. Phila., Pa.

POWER PLANT EQUIPMENT

Special Offerings

TURBO-GENERATORS

1—6000 KW. G.E. 2300/4000
1—2000 KW. 600 V. Cond.
1—1500 KW. 2300 V. Cond.
1— 750 KW. 2300 V. Cond.
1— 750 KW. 600 V. Cond.
1— 500 KW. 550 V. Cond.
1— 500 KW. 440 V. Non. C.
1— 500 KW. 125 V. D.C.
1— 375 KW. 440 V. Cond.
1— 120 KW. 440 V. Non. C.

ENGINE GENERATORS

1—168 KW. 550 V.
2—280 KW. 440 V.
1—600 KW. 2300 V.
1— 75 KW. Uniflow 240 V.

TURBINES ONLY

1—375 H.P. with gears
1—210 H.P. Terry 250#
1—100 H.P. G.E. with gears

BOILERS

1—1390 H.P. 400# Coal
2— 480 H.P. 225# Coal
1— 360 H.P. 190# Coal
2— 300 H.P. 250# Coal
1— 260 H.P. 200# Coal
2— 175 H.P. 200# Oil
4— 150 H.P. 150# H.R.T.
2— 100 H.P. 135# Coal
1— 70 H.P. Ames Ecom.

MOTOR

1—1250 H. P. G.E. Syn. Engine Type 2300 V.

AIR COMPRESSORS

1—6700 C.F. 22# Turbine Driven
1—1600 C.F. 50# Steam
1—860, C.F. 50# Diesel
1—1247 C.F. 55# Motor
1—1214 C.F. 100# Motor
1—600 C.F. 350# Steam
2—136 C.F. 100# Belted

AIR TANKS

3—10' x 36" Mass. Std.

CONDENSERS

1—3100 Sq. Ft. Worth.
1—1485 Sq. Ft. Wheeler.

Write or wire for additional data and prints.

A. LEE ELLIS CO., U. S. Mchy. Bldg., Boston, Mass.

The Buyer Must Be Satisfied—Always

SLIP RING MOTORS
3-PH., 60 CY.

HP	Volts	Make	Speed
900	2300	G.E.	900
500	2300	G.E.	900
400	2300/440	Whse.	400
400	2300/440	G.E.	600
350	2300/440	G.E.	600
300	440	Al. Chal.	900
300	2200/440	G.E.	600
300	2200	G.E.	1800
250	2300	G.E.	600
250	440/550	G.E.	600
200	2200/440	G.E.	600
150	2200	G.E.	450
150	2200/440	G.E.	600
125	440/220	G.E.	1200
125	440/220	G.E. (Hoist)	900
100	220/440	G.E.	720
100	440/220	G.E. MTC	900
100	550	G.E.	900
100	2200	G.E.	900
100	2200	G.E.	1800
75	2200	Al. Chal. (new)	900
75	440/220	G.E. (MTC)	600
75	2200/440	G.E.	1200
50	2200/440	G.E.	600
75	550	G.E.	900
60	2200	G.E.	900
40	2200	Whse.	900
40	2200	G.E.	1200

SYNCHRONOUS MOTORS
3-PH., 60 CY.

300	440/220	Al. Ch.	600
200	2200	Whse.	900
110	440	Whse.	900
100	2200/550	Al. Ch.	1800
100	440/220	G.E.	360
75	440/220	G.E.	720

OUTDOOR OIL CIRCUIT BREAKERS

1—New 400 Amp. Type FK. 136-1328A, General Elec. 3PST, 25,000 Volt Oil Switch, Interrupting Capacity 125,000 KVA, complete CT's PT's, etc.
3—NEW 400 amp., Type FKO 227, G. E., 7500 V., outdoor type, hand-operated.
1—3000 ampere, type FK 25, General Electric, 3 pst, 600 volt.

TRANSFORMERS
60 CYCLE

4—1250 kva, Al. Chal., 13800-460/230 V.
3— 833 kva. Whse., 11000-2300 V.
3— 500 kva, G.E., type H, form KS, 13800-230/460.
3— 333 kva., G.E., 66000-480 V.
1— 300 kva., Whse., 3 Ph., 13800-230 V.
3— 250 kva., Whse., 13,800-460.
3— 200 kva., Whse., 11000Y-2300 V.
3— 200 kva., G.E., 13200-480 V.
6— 200 kva., G.E., NEW PYRANOL, 2300-450 V.
2— 150 kva., G.E., type HTQ, 4150-240/480 V.
3— 150 kva., G.E., H-KDD 13200-2300.
3— 150 kva., G.E., H-KS, 2400-240/120 V.
3— 100 kva., G.E., type H 2400-240-480.
3— 100 kva., G.E., type H-KDD, 6900/11950V-230/115.
3— 100 kva., G.E., type H-KR 6600/11430V-2300 V.
3— 100 kva., G.E., H-KDD, 6600/11950-230/115 V.
3— 100 kva., G.E., H-KS, 2400-240/480 V.

TURBO-GENERATOR SET

1—112½ kva., 1200 rpm., 220/440 v., 3 ph., 60 cy., G.E., conn. to Terry, 3600 rpm., non-cond. turbine, 100/150 lbs. gu.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
500	440/220	G.E.	IK	900
400	2200/440	Whse.	CS	720
300	440	Whse.	CS	450
250	2200/440	G.E.	IK	600
250	2200	G.E.	IK	450
200	440/220	G.E.	IK	1200
150	440/220	G.E.	KT	720
150(3)	440/220	G.E.	KT	1200
125	440	G.E.	K	514
125	440/220	G.E.	KT	1800
125	440/220	G.E.	KT (Vert.)	1800
100	440	G.E.	IK	450
100	2200	G.E.	KT	1800
100	440	Whse.	CS	1200
100	550	Cr Wh.		720
100	550	G.E.	KT	900
74	2200	G.E.	KT	900
50	2200	Al. Chal.		720

MOTOR GENERATOR SETS

1—75 KW, 250 V, 850 RPM, conn. to 110 HP, 440/220 V. Sq. Cage Motor.
1—50 KW, 250 V. 850 RPM. Whse. conn. to 75 HP. 440/220 V. 3 ph. 60 cy. Sq. Cage Motor.
1—50 KW, 125 V., 1200 RPM, Whse. conn. to 75 H.P. 2200/220 V.; 3 ph., 60 cy., Sq. Cage Motor
1—35 KW, 125 V., 1800 RPM., G.E., conn. to 50 HP., 440/220 V., 60 cy., squirrel cage.

A.C. GENERATORS

1—375 kva, 514 rpm, 480/240 V. G.E.
1—250 kva, 600 rpm, 440/220 V. Al. Ch.
1—200 KVA, 600 RPM, 4150/2300 V., Cr. Wh.
1— 96 kva, 360 rpm. 480/240 V. G.E.

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

2—4000 KVA. 60 Cy. 3 PH. TURBO WITH SURFACE COND.

1—3125 Kva. G.E. Turbo 230 V. 60 Cy. 3 ph.
100 KW. 550 V. 3600 Rev. 60 CY. 3 PH. turbo with exciter.
1500 CFM 2 STAGE AIR COMP. 275 HP. 60 CY. 2200 V. Syn. Motor Dr.
2—Cent. Pumps 4166 GPM, 162' Head, 1750 Rev.
1—36000 GPM. 27' or 25000 GPM 40' Hd. 285 Rev. Cent. Pump.
2—50 KW. 480 V. 60 CY. 3 PH. OIL ENGINE SETS.
1—187 KVA. 480 V. 60 CY. 3 PH. 225 Rev. Engine Set.
1—312 KVA. 480 V. 60 CY. 3 PH. 200 Rev. 4 Valve Rebuilt Eng. Set.
1500 and 2500 HP. 60 CY. A.C. Motors. 435 and 257 Rev.

ROSS POWER EQUIPMENT CO. Indianapolis 4, Ind.

ELECTRICAL EQUIPMENT
FOR
INDUSTRY

LET US KNOW YOUR REQUIREMENTS

MERCURY ARC RECTIFIERS

1—1500 KW, 250 V—DC, 22000 V—AC, 3 PH.
1—1000 KW, 250 V—DC, 4000 V—AC, 3 PH.
2—1000 KW, 600 V—DC, 4000 V—AC, 3 PH.

MOTOR GENERATOR SETS

1—150 KW, 275 V—DC, 2300 V—AC, 3 PH.
1—100 KW, 275 V—DC, 2300 V—AC, 3 PH.

JOHN D. CRAWBUCK COMPANY
714 Ark Way North Side Pittsburgh 12, Pa.

TRANSFORMERS

3—833 KVA 13200—240/480 V.
3—833 KVA 11000—2300/3985Y V.
3—667 KVA 6930/12000Y—2300 V.
3—333 KVA 66000—480 V.
3—333 KVA 23000—575 V.

One Year Guarantee

THE ELECTRIC SERVICE CO., INC.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M Since 1912 CINCINNATI 27, OHIO

BOILERS

NEW and USED

All makes & sizes for prompt shipment
several attractive assorted sizes.

Special Offer
400-HP . . . . 175 lbs.
Stirling Boilers

J. F. DAVIS CO.
122 S. Michigan Ave. CHICAGO
Telephone Harrison 0755

COMPLETE POWER PLANTS

STEAM—ELECTRIC—HYDRO—DIESEL

"Export Orders Carefully Executed"

SPECIAL OFFERINGS

1—2000 H.P. B. & W., 200# Boiler
2—1060 H.P. Heine Boilers 200#
4— 1000 H.P. Heine 225# Boilers
2— 750 H.P. Edge Moor 200# Boilers
2— 750 H.P. B. & W. Sterling Boilers 200#
4— 600 H.P. B. & W. 200# Boilers
2— 600 H.P. Edge Moor 200# Stokers
4— 440 H.P. B. & W. Sectional 200# Oil fired
1— 335 H.P. B. & W. Sectional 200#
Smaller Boilers and Fire Tube Boilers also

1—15000 K.W., G.E. Co., Turbo-Generator Condensing
2—12500 K.W., G.E. Co., Turbo-Generator Condensing
1— 5000 K.W., G.E. Co., Turbo-Generator Condensing
3— 4000 KW., G.E. Co., Turbo-Generator Condensing
2— 2500 K.W., G.E. Co., Turbo-Generator Condensing
2— 2000 K.W., G.E. Co., Turbo-Generator Condensing
1— 2000 K.W., W. E. & M. Co., Turbo-Generator Con.
3— 1000 K.W., G.E. Co., Turbo-Generator Condensing
2— 750 K.W., G.E. Co., Turbo-Generator Condensing
Several 500 KWs. & Smaller. And Non-Cond. Units

50 Ton 69'-10" Overhead Traveling Crane

CHARLES B. REARICK 30 CHURCH ST. NEW YORK

FOR SALE

Power plant equipment. Steam, Diesel, electrical, boilers, engines, turbines, generators, new or used.

PENN MACHINERY COMPANY
Jackson, Miss.

BOILERS

2 ERIE CITY longitudinal, box header water tube boilers with Type-E. stokers, 400 H.P. (each) headers are equipped with KEY CAPS—OHIO, PENN'A. & ASME Stamping.

H. P. BREARLEY
3423-91St. Street Jackson Heights, N. Y.

REBUILT POWER EQUIPMENT

READY TO SHIP!

SLIPRING MOTORS—3 PH., 60 Cy.

H.P.	Make	Volts	R.P.M.	Type
15	G.E.	220/440	850	I
15	West.	220/440	870	CW
20	Westg.	220	575	CW
20	Allis. Chal.	440	1130	
50	West.	220/440	1120	HF
50	Chandeys'n	220/440	1800	
60	West.	220/440	1800	CW
75	G.E.	220/440	1200	I
150	G.E.	220/440	1200	M-1
200	G.E.	220/440	1200	M-1
250	West.	2200	900	CW
260	Burke	440	600	EMY-65
700	G.E.	2200	393	MT-432

ALTERNATING CURRENT MOTORS

3 ph. 60 cy.

H.P.	Make	Volts	R.P.M.	Type
45	West.	220/440	850	CS
50	West.	220/440	1800	CS
50	West.	220/440	870	CS
50	Al. Chal.	220/440	865	
50 32	G.E.	440	800/640	
60	Allis Chal.	220/440	1760	
60	West.	220/440	1200	CS
60	Allis Chal.	220/440	1200	
60	West.	220/440	1800	CS-T.E.
60	West.	220/440	1800	CS
75	Triumph	220/440	685	B-15
75	West.	220/440	1800	MS
100	Triumph	220/440	850	B-15
100	Allis Chal.	220	600	
125	West.	220/440	1800	CS
125	G.E.	220/440	1800	I
150	Wagner	440	1800	31V
150	West.	220/440	1800	CS
200	Westg.	2200	900	

VARIABLE SPEED MOTORS—230 VOLT D.C.

H.P.	Make	R.P.M.	Type
3	West.	300/2000	SK-43
3	Roth	500/1000	RS
3	G.E.	400/1200	RLC-114
4	G.E.	850/1700	LC-8
5	West.	400/800	SK-80
7½	West.	650/1300	SK-70
10	Westg.	565/1130	S-6
10	G.E.	625/1250	LC
10	West.	400/1600	SA-7
15	Reliance	500/1800	
15	West.	725/1450	SA-6
20	Westg.	750/1500	SK-110L
20	West.	625/1250	SA-6
20	West.	750/1500	SK-110L
30	G.E.	450/900	RI.C
50	West.	250/715	SK-185A
75	West.	400/650	SK-181
100	West.	300/900	SK-191

SERIES WOUND MOTORS

H.P.	Make	Volts	R.P.M.	Type
10	West.	230	650	MT-00
15	Cr. Wh.	220	270	SM
15	West.	230	800	HD
25	West.	230	600	MT
25	Westg.	230	395	904
30	Westg.	230	525	MCA 50
32	Shaw	230	485	5L2E
32	G.E.	230	450	801
35	Westg.	230	550	49D
50	Cr. Wh.	230	500	SM
50	G.E.	230	550	MD-106
80	West.	230	490	76-A
80	G.E.	230	500	MD-107
85	Westg.	230	480	MCA 80
140	G.E.	230	410	MD
175	G.E.	230	475	MD

TRANSFORMERS

1 ph. 60 Cy.

No.	Kva.	Pri.	Sec.	Make
9	5	2200	110/220	G.E. & West.
58	7½	2200	110/220	G.E. & West.
21	15	2200/1100	440/220/110	West.
3	15	2200	110/220	Packard
3	15	2200	110/220	Cr. Wh.
6	18	220	19½/38½	El. Furnace
2	20	1150/2300	115/230	Maloney
1	20	2300	110/230	West.
2	20	2300/110	440/220/110	West.
1	25	2300	110/220	West.
9	37½	2400	480/240	G.E.
3	40	2300/1100	220/110	West.
1	40	1100/2200	110/220	Pittsburgh
1	40	2300/1150	113/230	Maloney
2	50	2200	110/220	Packard
2	50	2200/1100	220/110	Maloney
1	75	2400	240/480	G.E.
3	75	2400–4000Y	120/240	Al. Chal.
4	75	2400	240/480	G.E.
1	75	2400–4160Y	120/240	West.
3	75	2400–4160Y	240/480	Al. Chal.
3	5	2300	220/440	G.E.
3	100	2400	240/480	Al. Chal.
3	112.5	2400	240/480	G.E.
3	125	2200	220/440	G.E.
2	150	2200/2300/2400	220/230/240	G.E.
3	250	6600/5940	2300	West.
3	250	2300	460/230	Al. Chal.

D.C. CLARK CONTROLLER

1—250 HP Clark Vari time magneto controller 230 v. DC reversing, used for plugging service. Can also be used non-reversing.

MOTOR GENERATOR SETS—250 & 500 V. D.C.

1—200 KW 900 rpm. 500 v. DC West. Gen. dir. driven by 440 v. 3 ph. 60 cy. West. Syn. Motor

1—100 KW 500 v. DC Gen. 1750 rpm. dir. con. 150 HP 440 v. 3 ph. 60 cy. type CS Motor

1—100 KW 720 rpm. 250 v. West. Gen. dir. con. 2200 v. 3 ph. 60 cy. Syn. Motor

1—100 KW 1200 rpm. 250 v. West. type SK Gen. dir. con. 2300-440 v. 3 ph. 60 cy. Syn. Motor

3—100 KW 250 v. West. Gens. dir. con. 220/440 v. 3 ph. 60 cy. Motors

4—75 KW 250 v. West. Gens. dir. con. 440 v. 3 ph. 60 cy. AC Motors

2—65 KW 1800 rpm. 250 v. G.E. Gens. dir. con. 220/440 v. 3 ph. 60 cy. AC Motors

4—50 KW 250 v. DC Gens. dir. con. 220/440 v. 3 ph. 60 cy. AC Motors

2—40 KW West. 250 v. DC Gens. dir. con. 220/440 v. 3 ph. 60 cy. AC Motors

2—30 KW 250 v. DC cp.wd. Gens. dir. con. 220/440 v. 3 ph. 60 cy. AC Motors

2—25 KW 250 v. DC West. Gens. dir. con. 220/440 v. 3 ph. 60 cy. Motors

WRITE, WIRE OR PHONE YOUR ELECTRICAL NEEDS—SEND FOR STOCK LIST, LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

MOTORS • GENERATORS • TRANSFORMERS

MOTORS

3 phase, 25 cycle, 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	G.E.	KT327	750	1781884
15	Allis Chal.		720	84242
15	G.E.	I-K	750	685100
15	West.	CCL	1500	816324
20	West.	CS	715	2691183
20	West.	CS	730	1919877
15	Otis	15	750	1017787V
20	Allis Chal.		720	3K28825
20	Warner	BP22T	750	119028
20	Reliance		720	Z20194
25	Allis Chal.	AR20A	750	220-A-623-4209-3
25	G.E.	14	750	292596
25	Rob. & Myers	K	720	P51536
25	Triumph	TR12	750	C14248
30	Wagner	22VBMS	710	127097
30	Wagner	22VBM3	725	171477
30	West.	CCL	710	602618
30	G.E.	KT327	1440	2302731
40	West. (2200 v.)	CCL	710	854121
38	Otis	AC 750/187½		70062Y
38	Otis	AC 750/187½		70061Y
40	Wagner	22TLBP	1425	318604
40	West.	CCL	710	1032102
50	G.E.	I-K	1455	4015021
75	West.	CS	735	2207524
100	West.	CCL	480	808349
125	Allis Chalmers	AR	1500	
150	G.E.	I-K	363	2246835
150	G.E.	I-K	365	2246834
150	G.E. (2200 v.)	KT557Y bb	1460	5227355
225	Elec Mach.(2200/440syn.)		500	504129
1150	G.E.	ATI (syn.)	375	695425

MOTOR GENERATOR SETS

1—50 KW Gen. Elect. Type DLC 203 1200 RPM 3 Bearing Mactory Built Motor Type I. Form K. 3/220/60/1200 RPM.

1—125 KW Ridgeway 250 V DC 1200 RPM, direct connected to 180 HP. Ridgeway Motor 3/60/440 Volts 1200 RPM DC. Panel and Starting Compensator.

TRANSFORMERS

3— 75 KVA Niagara—New—OISC 60/1/2400/120/240
6—100 KVA Niagara—New—OISC 60/1/2400/120/240
3—150 KVA Niagara—New—OISC 60/1/2400/240/480

REBUILT MOTORS

3 Phase 60 cycle 220/440 Volts

HP	Make	Type	RPM	Serial No.
15	Crocker-Wheeler		600	131413
15	Westinghouse	CS	1200	1883285
15	Westinghouse	MS	1200	9445931
20	Westinghouse	CS	1200	2160500
20	Westinghouse	MS	1200	1056826
20	Westinghouse	MS	1200	1246745
20	Westinghouse	MS	1200	1056827
20	Westinghouse	CS	1800	1863526
20	Westinghouse	CS	1800	1930159
20	Westinghouse	CS	1800	2695044
25	Westinghouse	MS	1800	1662026
25	Westinghouse	MS	1800	1334763
25	Westinghouse	CS	1200	2286768
25	Westinghouse	MS	1200	1197673
25	Wagner	BP	1200	126906
30	Armor	BB	720	4343
30	Crocker Wheeler		720	17270
30	Westinghouse	MS	1200	1197674
30	Fairbanks-Morse	V-H-10D	1800	43476
40	Westinghouse	CS	900	1896969
40	General Electric	I-K	1800	73318
40	General Electric	I-K	1800	68511
40	General Electric	I-K	1800	77017
40	General Electric	I-K	1800	73316
40	Westinghouse	MS	1800	1506800
40	Westinghouse	MS	1800	1051548
40	Westinghouse	MS	1800	1056802
40	General Electric	I-K	1200	181444
40	Westinghouse	MS	1200	1027421
50	Westinghouse	MS	1800	1289389
50	Westinghouse	MS	1200	854410
50	Westinghouse	CS	1800	2691183
50	Westinghouse	CS	1800	1949877
50	General Electric	14	1800	181444
50	General Electric	KT-352	720	
50	Reliance		1800	Z20194
50	Allis Chalmers		1800	3K28825
60	Westinghouse	CS	900	4884402
60	Reliance		1200	B11458
60	General Electric	I	1800	292596
60	Westinghouse	CCL	1800	329654
60	Robbins-Myers	K	1800	P515362
60	Triumph		1800	C14248
60	Westinghouse	CCL	1200	854121 (2200 v.)
75	Westinghouse	CS	1800	2134671
100	Westinghouse	CS	900	2207524
100	Westinghouse	CCL	1800	1043213
100	Westinghouse	CCL	1800	765231 (3300 v.)
125	Westinghouse	CS	1200	2318625
150	General Electric	KT568	450	
150	Westinghouse	CS	1800	2429726
150	Westinghouse	CCL	900	438385
150	Westinghouse	CS	1200	4572596 (2200 v.)
150	General Electric	I-K	720	122809 (2200 v.)
150	Westinghouse	CCL	720	808349 (2200 v.)
200	General Electric	KT568	514	
200	General Electric	I-K	900	232917 (2200 v.)
200	Westinghouse	CCL	900	919537 (2200 v.)
250	General Electric	KT568	600	
250	General Electric	I-K	600	2246834
300	General Electric	KT568	720	
300	General Electric	I-K	720	2357743
400	General Electric	I-K	900	2347845
400	General Electric	KT568	900	

SLIP RING MOTORS

3 Phase 60 cycle 220/440 Volts

HP	Make	Type	RPM	Serial No
20	Westinghouse	CW644C	575	8009992
20	General Electric	MT332	545	3889010
30	Westinghouse	HF	1745	1558408
40	Westinghouse	CW748	690	4406823
250	Allis Chalmers	3 bearing	505	1043901 (2300 v.)
400	General Electric	I-M	900	224674
400	General Electric	I-M	900	246762

MAGNETIC CONTACTOR

400 HP. Gen Elec. Type CR 7006. Form D12D. 3/60/440 Volts.

25 CYCLE GEARHEAD MOTORS

2—3 HP. Gen. Elect. Shaft Speed 30 RPM.
6—1½ HP. Gen. Elect. Shaft Speed 99 RPM.
4—4½ HP. Gen. Elect. Shaft Speed 97 RPM.
3—5 HP. Gen. Elect. Shaft Speed 30 RPM.

WELDERS

1—300 AMP. Lincoln Shield Arc—60 cycle.
1—400 AMP. Lincoln Shield Arc—25 cycle.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

1—440 HP Elec. Machinery, 3-60-440V, 900 RPM, two bearing syn. motor
1—300 HP General Electric, 3 phase, 60 cycle, 440 volt, 360 RPM, type Mt 412 slip ring motor
1—275 HP Allis-Chalmers, 3 phase, 60 cycle, 440 volt, 1175 RPM slip ring motor
1—250 HP General Electric, 3-60-440V, 450 RPM, type 1-M slip ring
1—200 HP Westinghouse, 3-60-2200V, 600 RPM syn. #4956114, direct conn. exciter and starter
2—100 HP General Electric, type I, form K, 3-60-220V 575 RPM
2—100 HP, General Electric, type 1-17, from K, 3-60-440V, 350 RPM
1—100 HP Westinghouse, type CCL, 3 ph. 60 cy., 2200 V. 1750, Squirrel Cage
1—100 HP Allis-Chalmers, type ANY, 3 ph. 60 cy., 220V, 580 RPM slip ring
1—100 HP General Electric 3 ph. 60 cy. 4000V, 720 RPM syn., type TS with direct connected exciter
1—150 HP Allis-Chalmers 3-60-440V, 450 RPM slip ring
3—100 HP, General Electric, 3-60-440V, 450 RPM sq. cage
4—75 HP G. E. 3-60-2300V, 400 RPM, type I, sq. cage
1—75 HP General Electric, type KT, frame 562, 3-60-440V, 450 RPM
1—75 HP Fairbanks-Morse, type H, frame 105C, 3 ph, 60 cy, 550V, 900 RPM Squirrel Cage
1—75 HP Lincoln, type 1Q, 3 ph. 60 cy. 3 phase, 440V, 600 RPM Squirrel Cage
2—75 HP Fairbanks-Morse, 3 phase, 60 cycle, 2200 volt, 1800 RPM, slip ring motors
1—60 HP Lincoln 3-60-220V, frame 1XM, 900 RPM slip ring
1—50 KW factory built m-g set, 125 Volt, Ideal 900 RPM driven by 75 HP, sq. cage 220/440 V. motor
1—60 HP, General Electric, 3-60-440V, 720 RPM, type I, form K
1—60 HP General Electric, 3-60-440V, 1750 RPM, type I slip ring
1—60 HP General Electric, 3 phase, 60 cycle, 440 volt, 600 RPM, type MT 558 slip ring motor
1—50 HP General Electric 3-60-220V, 1150 RPM, type I, slip ring
1—50 HP Triumph 3-60-440V, type C12 1150 RPM, slip ring, rotor & stator rewound
1—50 HP General Electric, 3-60-440V, 900 RPM, type I-M, slip ring
1—50 HP General Electric, 3-60-440V, 720 RPM, type IK, Sq. Cage
2—50 HP Allis-Chalmers, 3-60-440V, 720 RPM, slip ring
1—50 HP General Electric, 3-60-440V, 690 RPM, MT 546, slip ring
1—50 HP Wagner 3-60-440V, 495 RPM, type BM, Sq. Cage
1—50 HP Allis-Chalmers, 3-60-440V, 490 RPM, Sq. Cage
1—50 HP Westinghouse CS 2-60-440V, 420 RPM, Sq. Cage
1—50 HP General Electric type I-M, 3 ph. 60 cy. 440V, 720 RPM slip ring
1—45 KVA Fairbanks-Morse, 3 ph. 60 cy. 220 V, 1200 RPM alternator
2—30 HP Fairbanks-Morse, 3 ph. 60 cy. 2220V, 3600 RPM, type HO, frame 12B ball bearing
1—50 KW, Allis-Chalmers, factory-built, 3 bearing M-G set, 125 volt DC driven by 75 HP, 3 phase, 60 cycle, 220 volt 1165 RPM motor
2—175 HP, 230V, DC Westinghouse, type SK, 150 to 550 RPM
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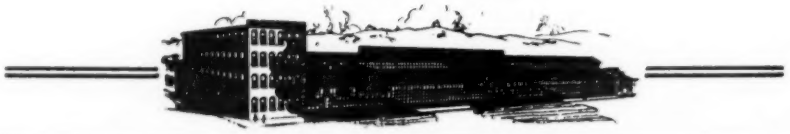

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1—2000 KW General Electric Turbo-Generator, 2500 KVA, 6600 Volts, 219 Amps, 3600 RPM, Type ATB, Form HT, direct-connected exciter with Elliott Jet Type Condenser, Serial No. 4219008.
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1—2750 KW General Electric Turbo-Generator. Steam pressure 150 lb., A.C. Generator, Type AQB, Class 4—Form HT, Speed 1800 RPM, Volts 2300, Amps 598. W.M. Kellogg Co. Twin Bulkley Injector Condenser.
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2	100	G. E.	IK	1800
1	150	West.	CS	1800

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1	50	G. E.	I-M	900
1	60	G. E.	I-M	900
1	75	West.	CW	900
1	250	West.	CW	1200

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1	25	West.	SK	400/1200
1	50	West.	SK	500/1500
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3000KW Wemco 200# 100° 15# g. ext. surf. cond.
4000KW GE 350# 600°TT 2300V surf. cond.
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25	NEW Sheppard	6A-1	15	110–220	1800
50	NEW Sheppard	12	25	110–220	1800
100	NEW International	UD-14	62½	110–220	1800
130	Caterpillar	D-13000	82½	220	900
60	Fairbanks	Y-VA	47½	2300 or 220	257
105	Murphy	ME-4	62½	220	1200
135	Murphy	ME-6	82½	220	1200
135	Fulton Legionnarie	L	100	220	600
240	Fairbanks	Y-VA	200	220–440–2300	257
360	Fairbanks	Y-VA	300	2300	257

DIESEL ENGINES

H.P.	Engine	Model	Cyl.
25	NEW Sheppard	6A-1, clutch, radiator, elec. starter	3
55	Fairbanks	47 Stub shaft, starting equip.	1 horiz.
60	Fairbanks	Y-VA Stub shaft, starting equip.	1 Vert.
60	Fairbanks	34-B Marine with marine clutch	4 Vert.
135	Fulton	L	4 Vert.
105	Murphy	ME-4, Radiator, elec. starter and gen.	4
135	Murphy	ME-6, Radiator, elec. starter and gen.	6
150	Fairbanks	HD-4400, dredging engine, 8¼x10½	5
200	Fairbanks	Y-VA	4
240	Fairbanks	Y-VA, with stub shaft	4
300	Fairbanks	Y-V, with stub shaft	6
360	Fairbanks	Y-VA, with stub shaft	6

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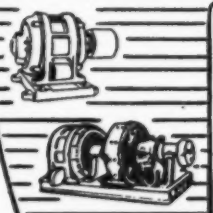

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200 KVA late style Diesel job, 2300 volts, 3 phase, 60 cycle. Prefer moderately high speed unit.

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Separate belt driven exciter—15 KW General Electric, 125V-120 A-750 rpm—form A, type RC12, serial No. 646886.

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Both Generators recently rewound

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22586	.072″ (#13 Awg.)	Asbestos Insulated, Reels	134#
22587	.081″ (#12 Awg.)	Single Glass Covered, Round	2,000#
22588	.081″ (#12 Awg.)	Single Glass Covered, Round	685#
22591	.049″ x .437″	Double Cotton Covered, Rect.	645#
22592	.051″ x .114″	Double Glass Covered, Rect.	1,530#
22593	.051″ x .325″	Double Cotton Covered, Rect.	499#
22595	.057″ x .365″	Double Glass Covered, Rect.	493#
22598	.064″ x .325″	Asbestos Insulated, Rect.	130#
22599	.064″ x .365″	Asbestos Insulated, Rect.	958#
22604	.102″ x .289″	Asbestos Covered, Rect.	604#
22605	.102″ x .325″	Double Glass Covered, Rect.	10,199#
22606	.106″ x .256″	Double Glass Covered, Rect.	180#
22607	.114″ x .258″	Double Glass Covered, Rect.	485#
22615	.182″ x .289″	Double Cotton Covered, Rect.	672#
618	.100″ x .400″	Double Glass Covered, Rect.	1,074#
619	.035″ x .155″	Double Vitreous	1,681
620	.070″ x .250″	Double Vitreous	4,726
621	.110″ x .185″	Double Vitreous	3,160#
622	21 Awg.	Single Vitreous	2,700#
624	17 Awg.	Double Cotton Covered, Enameled	7,000#
625	34 Awg.	Triple Formvar	1,469#
26285	.0008″ Dia. (#52 Awg.)	Enameled	1,015#
26286	.0005″ (#36 Awg.)	Enameled Dbl. Scrape Hardness	150#
26287	.1113″ (#29 Awg.)	Single Glass Covered	338#
26290	.0201″ (#24 Awg.)	Enameled Syn.	1,466#
26292	.036″ (#19 Awg.)	Single Cotton Covered Enameled	755#
26293	.0403″(#18 Awg.)	Asbestos Insulated	209#
26294	.057″ (#15 Awg.)	Enameled with one rap of Manlia Rope Paper	17,376#
26295	.072″ (#13 Awg.)	Enameled	448#
26296	.025″ x .410″	Double Glass Covered	1,500#
26297	.032″ x .365″	Double Glass Covered	8,045#
26298	.040″ x .365″	Double Glass Covered	4,184#
26299	.063″ x .625″	Double Cotton Covered	265#
26300	.081″ x .289″	Double Glass Covered	2,184#
26301	.091″ x .124″	Double Cotton Covered	231#
26302	.091″ x .289″	Double Glass Covered	2,000#
26303	.102″ x .129″	Double Cotton Covered	513#
26304	.102″ x .258″	Double Glass Covered	2,189#
26305	.114″ x .289″	Double Glass Covered	1,515#
26306	.129″ x .258″	Double Glass Covered	1,687#
26307	.129″ x .289″	Double Glass Covered	1,757#

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Wagner Co., Arthur	321
Wente Electric Co.	324
Wilms, Weaver & Co.	319
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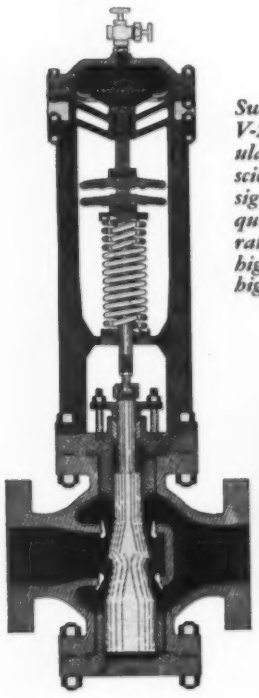
Protect your low pressure low temperature equipment with

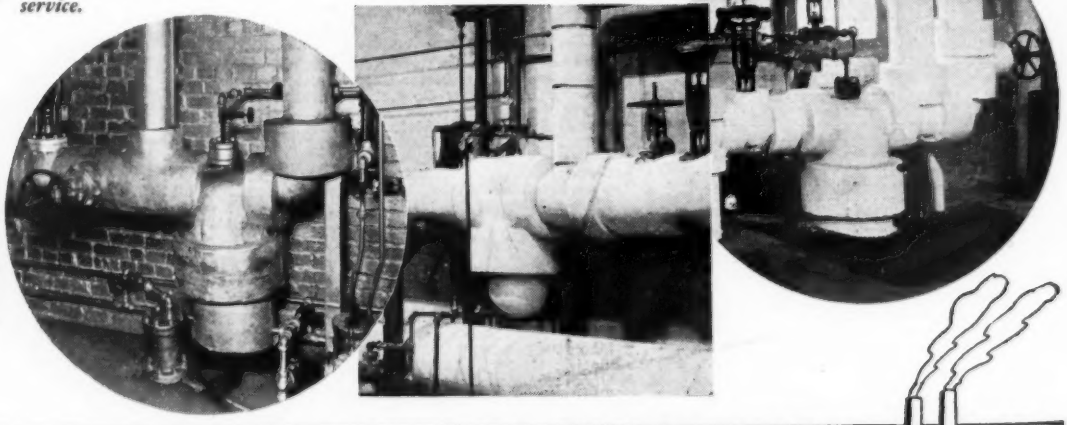
Harnessed Power

Swartwout sensitive, accurate *Reducing and Desuperheating Controls* assure safety and uniform results

IT'S just as important to reduce steam temperature and pressure *accurately* for "down the line" uses as it is to convert high powered steam at all. Swartwout Equipment is widely known for its consistent, sensitive performance. • New improvements in pressure reducing valves and temperature controls assure even greater regulating precision and safety. Your complete reducing and desuperheating station may be engineered by Swartwout, with special safety features if required. You can depend on the Swartwout guarantee of performance, based on many years of wide experience in the power plant equipment field. • For a modern, completely automatic reducing and desuperheating station, check your plans with Swartwout, or ask your consulting engineer.

Swartwout Type V-2 Pressure Regulating Valve — scientifically designed for smooth, quiet and accurate operation on high pressure — high temperature service.

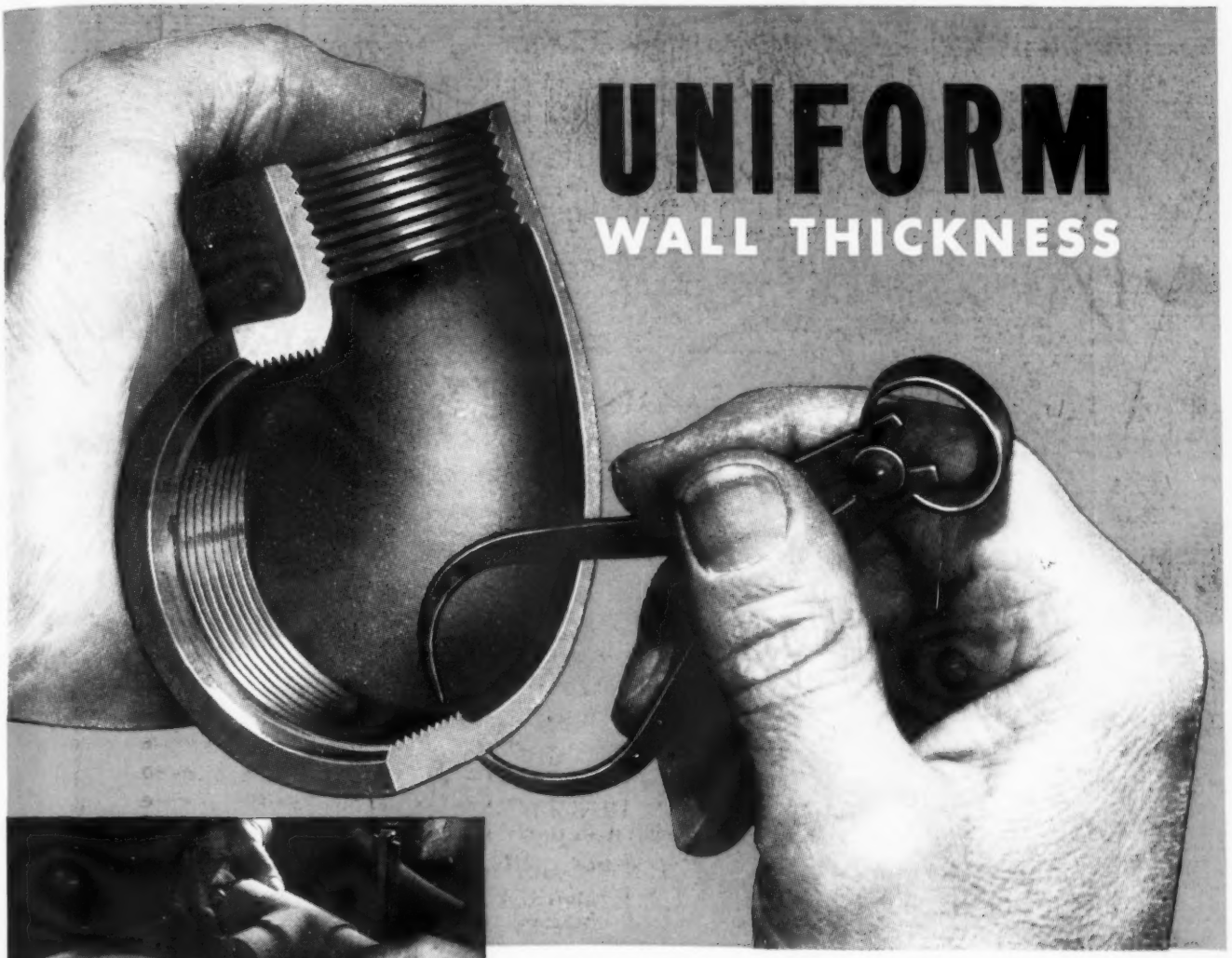




Swartwout POWER PLANT EQUIPMENT

THE SWARTWOUT COMPANY • 18511 Euclid Ave., Cleveland 12, Ohio

UNIFORM
WALL THICKNESS



Careful setting of cores assures uniform wall thickness.

. . . yet Grinnell Pipe Fittings cost no more

Rigid standards of manufacture, strictly maintained, make every Grinnell Pipe Fitting a *good fitting*. Their uniformity of wall thickness, for instance, is assured by Grinnell's high-grade pattern equipment and careful setting of cores. Other features which make every Grinnell fitting easy to use include: smooth surfaces inside and out, sharp, clean threads for easy starting and tight joints, and accurate sizing. Specify Grinnell Fittings – with the Grinnell "G" trade mark – and you get uniformly fine fittings at no increase in cost. Available through branch warehouses and jobbers everywhere. Write for Catalog 5-B. Grinnell Company, Inc., Executive Offices, Providence 1, R. I.

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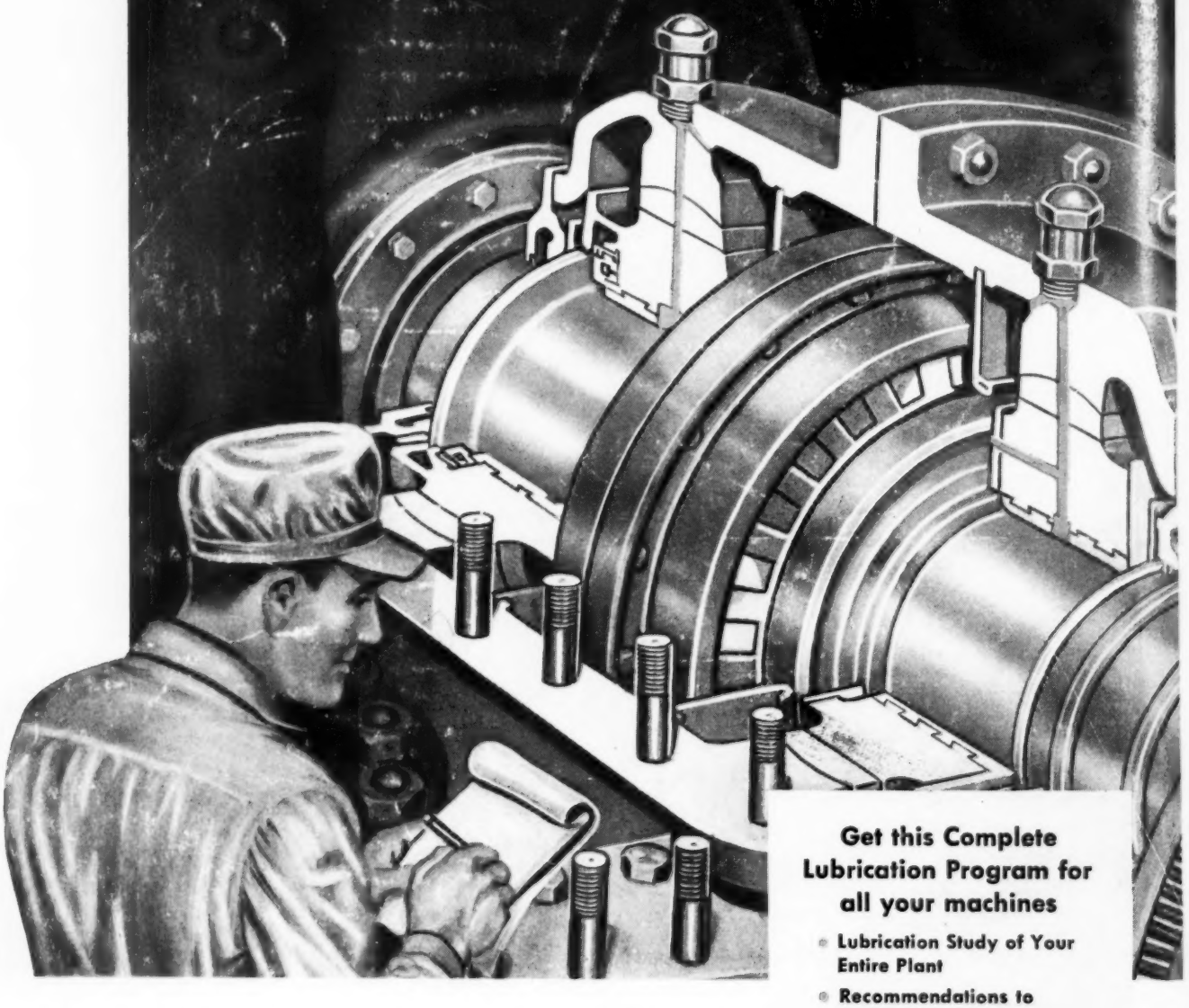
WHENEVER **PIPING** IS INVOLVED

What's in this New Turbine Oil for you?



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